Bulletin No. 41. *November, 1944.*

UNIVERSITY OF ALBERTA
COLLEGE OF AGRICULTURE

Care and Feeding of Dairy Cattle

BY

DEPARTMENT OF ANIMAL SCIENCE

Distributed by
Department of Extension, University of Alberta
Edmonton, Alberta, Canada

Bulletin No. 41. *November,* 1944.

UNIVERSITY OF ALBERTA
COLLEGE OF AGRICULTURE

Care and Feeding of Dairy Cattle

BY

DEPARTMENT OF ANIMAL SCIENCE

Distributed by
Department of Extension, University of Alberta
Edmonton, Alberta, Canada

COMMITTEE ON AGRICULTURAL EXTENSION AND PUBLICATIONS

ROBERT NEWTON, B.S.A., M.Sc., Ph.D., D.Sc., F.R.S.C., President of the University, Chairman.

R. D. SINCLAIR, B.S.A., M.S., Ph.D., Dean of the Faculty of Agriculture, Vice-Chairman.

F. A. WYATT, B.S.A., M.S., Ph.D., Professor of Soils.

J. MACGREGOR SMITH, B.S.A., Professor of Agricultural Engineering.

J. P. SACKVILLE, B.S.A., M.S., Professor of Animal Science.

E. H. STRICKLAND, M.Sc., Professor of Entomology.

H. R. THORNTON, B.Sc., Ph.D., Professor of Dairying.

J. S. SHOEMAKER, B.S.A., M.Sc., Ph.D., Professor of Horticulture.

A. G. McCALLA, B.Sc., M.Sc., Ph.D., Professor of Field Crops.

DONALD CAMERON, B.Sc., M.Sc., Director, Department of Extension, Secretary.

TABLE OF CONTENTS

TABLE OF CONTENTS—Continued

Care and Feeding of Dairy Cattle

BY

J. E. BOWSTEAD

Dairying in Alberta began with the early settlers and has grown in importance as the population has increased. Experience has shown that conditions in certain areas of Alberta are suitable for dairying. There has been a steady increase in dairy production to the extent that for many years there has been a surplus of dairy products in the province, largely in the form of butter.

Prior to World War II the farm value of milk production in Alberta was $12,000,000 to $14,000,000 per year as compared with a farm income from live stock marketings of $22,000,000 to $23,000,000. An additional income of $5,000,000 was derived from the processing of dairy products. In 1943 the farm value of milk production amounted to over $25,500,000. The doubling of income from dairy production during war years has been largely due to the increased wartime prices since there has been an increase of only 5% in milk produced.

Not only has there been an increase in the dairy cattle population, but what is more significant, there has been an increase in the yearly production of the average dairy cow. In 1938 it was estimated that the average production of dairy cows in the province was 3,770 lbs. of milk and 135.7 lbs. of butterfat, whereas by 1943 it had risen to 4,757 lbs. of milk and 171.3 lbs. of butterfat. This has been accomplished not only by an improvement in feeding practices, but also by the increased use of better sires and the establishment in the province of pure-bred herds, which have become an important source of breeding stock for the dairymen of Alberta as well as breeders in Canada and the United States.

While some improvement in production has taken place, the relatively low average yield per cow in Alberta indicates that further increases are possible by continued improvement in breeding selection and feeding practices.

In districts most suited to dairying, and especially those districts reasonably close to the larger urban centres, dairying has become an important farm enterprise. The investments in dairy buildings, herd and equipment are substantial, and dairying in these areas has become permanently established.

It should be recognized that there are many districts in the province where specialized dairying cannot be depended upon for the chief source of income. These areas do not provide the conditions for specialized dairying and are more suited to mixed farming practices. Crop and economic surveys conducted in the province indicate that there are still many areas suited to a mixed type of farming in which dairying may occupy an important place when combined with the raising of hogs, poultry or cash crops.

In the event that dairying is to continue as an important industry, it is suggested that improved methods must be adopted in order to increase the net return and at the same time to meet the competition of other farm enterprises. Guidance is also needed in properly establishing dairy herds in areas suited to mixed farming. This bulletin has been published for the purpose of giving practical advice to those already engaged in dairying and to farmers who may be considering establishing dairy herds.

REQUISITES FOR PROFITABLE DAIRYING

Dairying is regarded as an intensive farm enterprise because relatively more capital and labor is required to produce a dollar's worth of product than in the case of most other farm products. Dairying also necessitates a particular knowledge of practices involved in the breeding, feeding, maintaining the health of the herd, and care of the raw product, hence it follows that only those farmers with these qualifications and an adaptability and liking for this type of farm production are likely to make a success of the business.

The Dairy Cow Must be Well Bred.

Only those cows capable of producing enough milk to yield a reasonable income over costs of production can be considered profitable dairy animals. The ability to produce milk in large quantities is inherited, and therefore profitable cows are the result of good breeding and careful selection. The heavy producing dairy cow must be of a type which has been developed for the production of milk. She must have a strong frame, big barrel and large mammary development, since these characteristics are directly related to her ability to produce milk.

The Dairy Cow Must be Well Fed.

Dairying will only prove profitable when the cows are intelligently fed. Since all milk produced is indirectly derived from the feed, the feeding of cows becomes of paramount importance in successful dairying. The rations must contain all

the ingredients of milk and in the right proportion for maximum production and greatest economy. The dairyman must know the feed requirements of cows, the composition of feeds, the feeds most suitable for milk production and their cost, if he is to feed his cows most efficiently and secure maximum production from them.

Labor Must be Efficiently Utilized.

Dairying is not a seasonal enterprise. It is a yearly business in which work has to be done every day. The numerous chores that are necessary in dairying must be wisely, efficiently and regularly performed because carelessness and neglect in the proper care of the dairy cow reduces milk production.

Profitable Dairying Requires Both Brains and Brawn.

The combination of good breeding, intelligent feeding, and proper management constitutes the basis for profitable dairying. Any improvement made in the breeding, feeding or care of the herd will increase production as well as profit.

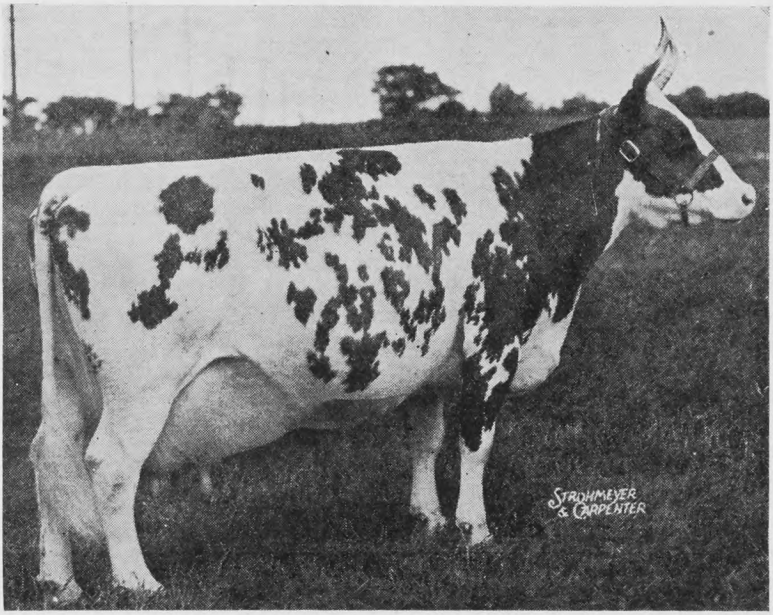


Fig. 1.—The highest scoring Ayrshire cow for type and outstanding producer. Barr Old Style, Imp.

THE IDEAL DAIRY COW

The ideal dairy cow is one which conforms to the type that makes the production of large quantities of milk physically possible. The type of cow and the ability to produce milk are related. When we breed for production, we also breed to get the type of animal associated with milk production. The superiority of the pure breeds of dairy cattle over scrub or most grade cattle is the result of over a century of constructive breeding and selection for both type and production. A knowledge of what consiitutes the ideal type is essential for the intelligent selection of both males and females if a profitable dairy herd is to be secured.

General Requirements.

An ideal dairy cow must be able to consume and digest large quantities of feed, convert them into milk, reproduce regularly and maintain health and vigor over a long period of years. To be physically able to do these things effectively, the cow must have (1) a large udder of good quality, long wide and strongly attached, with teats of fair size, properly placed, and milk veins that are prominent and tortuous, (2) a large barrel, which indicates a large feed capacity; the back carrying this barrel must be strong and straight, and the ribs long and well arched, and (3) a long, broad and level rump to give ample room for calving. Not only do spacious and well formed hind quarters aid reproduction, but they also make possible the development of a desirable mammary system. (4) A large heart girth gives ample room for the heart and lungs, so they will function normally to keep the cow in good health and to lengthen her period of usefulness. (5) Freedom from excess fleshiness when in milk is necessary because there should be a natural tendency for the food nutrients to be manufactured into milk rather than into beef or fat. (6) There should be beauty and style which result from the blending of well developed body parts into a symmetrical whole, and with an alertness and carriage which is pleasing to the eye.

BREEDS OF DAIRY CATTLE

Purebreds are Superior.

Improvement of dairy cattle dates back many centuries. The dairy herds developed as a result of careful selection and breeding for increased production, and for a type associated with production. Such planned selection and breeding has continued to be practiced within each breed until at the present time each of the pure breeds of dairy cattle are superior to non-purebred cattle for both type and production.

The Choice of a Breed.

The choice of a breed should be based upon the special qualities possessed by each of the different breeds, upon their suitability for conditions under which they will be raised, as well as upon the available markets for particular dairy products and breeding stock. All of the major dairy breeds are being successfully raised in the dairy districts of Alberta, and no one breed has proven to be superior to all others. There has been a tendency in the past for the breeds producing high test milk to predominate in creamery districts, whereas breeds producing milk of lower test predominate in cheese factory districts and large urban centres. If, however, a dairyman in a creamery area wishes to raise large numbers of swine or poultry that can utilize large quantities of skimmed milk, cows producing the lower test milk may prove more profitable under his conditions.

Select a Breed Popular in Community.

There are advantages for all dairymen in one community to raise the same breed of dairy cattle, or in districts where the dairy cows are not purebred to use purebred bulls of the same breed. Such a condition facilitates the purchase and sale of breeding stock within the community. In areas where there are many dairy herds of the same breed, it is possible to develop a popular strain of purebred cattle for sale outside the community.

A knowledge of breed characteristics is essential in making a selection of a breed. Each breed has its strong points as well as weaknesses. In making any selection, care must be exercised in obtaining animals that possess both good type and breeding, so as to avoid inherent weaknesses often found even among purebreds. The following information should aid in breed selection.

The Holstein-Friesian Breed

Holsteins in Canada have for many years outnumbered all the other dairy breeds combined, and in Alberta rank high in popularity. They are one the oldest breeds of dairy cattle, having been developed for centuries in the Rhine delta of Europe by the early tribes that settled in that area.

Holsteins are the largest dairy breeds, mature cows weighing from 1,300 to 1,600 lbs., and mature bulls from 2,000 lbs. up. They have strong, large frames and barrels, which gives them the ability to consume large quantities of roughage and pasture. Although Holsteins increase rapidly in size and weight, they reach sexual maturity comparatively slowly. They are usually bred to calve at from 27 to 30 months of age.

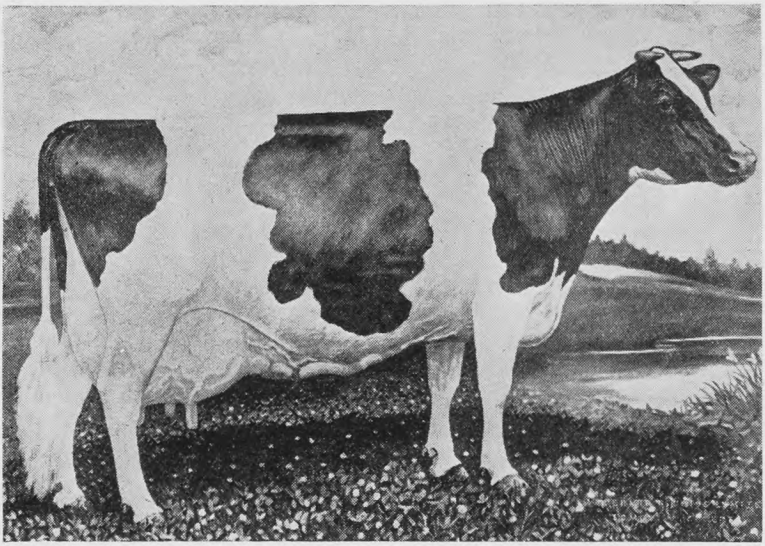


Fig. 2—True type, Holstein-Friesian cow

Cattle of this breed have strong, rugged constitutions and are hardy and healthy. While Holsteins have adapted themselves to a wide range of conditions, they do best where feed is plentiful.

Based upon production records of thousands of purebred animals, Holsteins produce more milk than those of any other breed, and although their milk may have the lowest average test, the production of butter fat is not surpassed. The highest production on record for a Holstein cow is that of Carnation Ormsby Butter King. She produced 41,943.4 lbs. of milk and 1,392.4 lbs. of butterfat in 365 days. Forty-six Canadian Holsteins have produced over 1,000 lbs. of fat and 21 cows have produced over 30,000 lbs. of milk in a year.

The color is black and white. Most purebred breeders prefer cows that are approximately 50% black and 50% white. Holstein cattle are moderately upstanding, with strong frames, spacious middles and good constitutions, which enable them to withstand cold and rigorous conditions. This fact does not imply that such conditions can be imposed without seriously affecting their milk producing ability.

Holsteins are noted for the extent of mammary development. While the udders are usually large, they are often not as well shaped nor as well attached to the body as is desirable. In former years many Holsteins were criticized for having

pendulous udders and large teats of poor shape. The rumps of some animals were inclined to be short or sloping, and this was partly responsible for the undesirable shape of some udders. During the past 25 years, purebred Holsteins have been considerably improved in general appearance and dairy form, and the common faults of the mammary organs and rump are being corrected.

Holsteins are docile and even tempered, but at the same time show the alertness and vigor which is desired in all dairy cattle. This breed can be successfully raised in all parts of Alberta where pasture and hay are plentiful, and where ample grain is fed to produce large amounts of milk. They are especially desired on farms where large quantities of skim-milk can be used for hog and poultry feeding, and also around large urban centres and cheese factories, where whole milk is required.

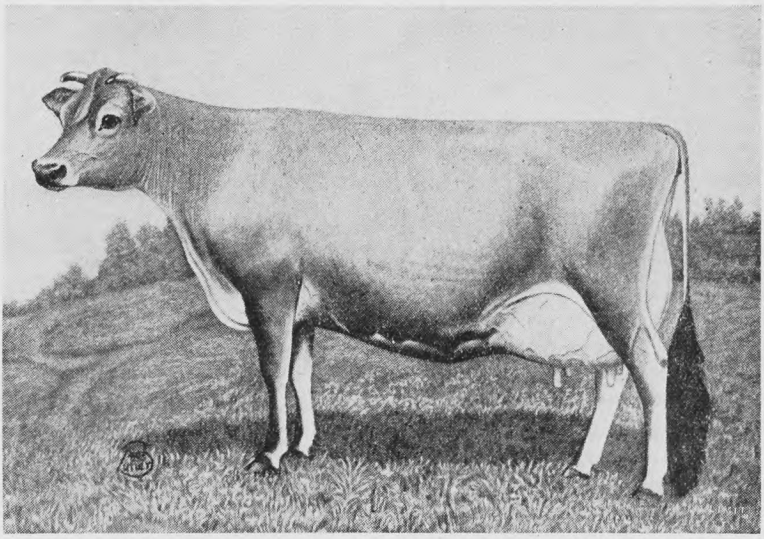


Fig. 3.—Standard type Jersey cow, approved by the Canadian Jersey Cattle Club.

The Jersey Breed

The Jersey breed of cattle is especially popular in creamery districts where butterfat production rather than milk is the major objective. Large numbers of Jerseys are also raised near the larger urban centres where there is a demand for milk with a high test. Jerseys have proven themselves to be adapted to most conditions prevailing in the better dairy districts of the province.

The homeland of the Jersey breed is the island of Jersey where centuries ago the people improved the dairy qualities of their native island cattle. In order to preserve these desirable qualities, the Government passed a law in 1763 which prohibited the importation of any live cattle to the island. Since that time the improvement has continued, and animals were being exported to all parts of the civilized world till 1939 when war was declared.

The breed is the smallest of the major dairy breeds. Mature cows weigh between 900 and 1,100 lbs., and bulls from 1,300 to 1,600 lbs. They are the most refined of all the dairy breeds, being relatively fine in bone and possessing those qualities considered ideal for dairy type. Considering their small size, Jerseys have large barrels, enabling them to make use of rations containing a large proportion of roughage. They mature rapidly and can be bred to calve at 24 to 26 months of age, or even earlier if well developed. Jerseys are also noted for their longevity, and many cows produce calves regularly to a relatively old age.

Jersey milk has the highest butterfat test. The high test milk produced by Jerseys reduces the feed requirement for butterfat production below that of lower testing breeds. While the average test of the milk is around 5.4%, many of the better animals of the breed average over 6%. As a result of the high test, Jersey cows are able to produce as much butterfat as those of any other breed. The world's butterfat record for Jerseys is 1,313 lbs., made by the Canadian cow, Brampton Basilua.

Jersey cattle range in fawn color from light gray, cream, yellow, red, even to dark brown. The lighter colors are the most popular. Solid colored animals are preferred to those with white spotting, although in recent years animals with white markings have been increasing in numbers. Bulls are usually darker in color. The muzzle is always black, but the tongue and switch may be either black or white.

The body type of the Jersey conforms very closely to the ideal for a dairy cow. Jerseys show pronounced dairy temperament as indicated by their freedom from excess flesh, quality of skin, and refinement of bone. The excess refinement of some animals may lead to weaknesses of body frame and lack of constitution, ruggedness and apparent thrift. The lack of size and extreme leanness of the Jersey make them of little value for beef or veal. The udder shape and body attachment is usually very good. Jerseys have a very active disposition and are very alert. Nevertheless they are very docile and are recognized as the family cow. When improperly managed

there is a tendency for some bulls of this breed to become unruly or vicious.

Jerseys are noted for their adaptability to most conditions. They are well adapted to humid and hot climates, but are not considered hardy enough to withstand exposure to extremely cold weather. While they may suffer more from the extreme cold of Alberta winters than certain other breeds, it is fair to say that such exposure is often the result of poor management. Jerseys have thrived on Alberta farms whenever they have been well housed and cared for.

The Ayrshire Breed

Ayrshire cattle have become better established in eastern Canada than in the western provinces. In Alberta the Ayrshire breed has gained a foothold in quite a number of districts and has contributed substantially to the dairy industry of the province. The Ayrshire breed had its origin in the county of

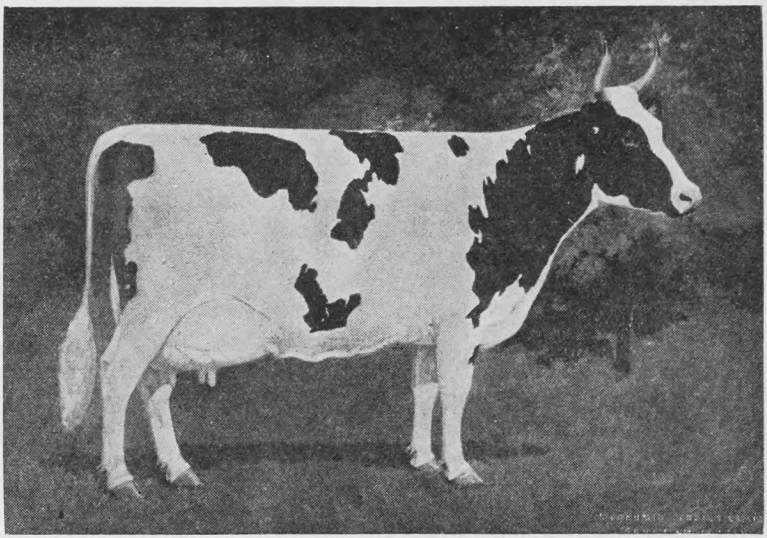


Fig. 4—Model Ayrshire cow.

Ayr in Scotland, where the climate was rigorous and feed none too plentiful. With the adoption of better agricultural methods, crop production increased and the livestock could be better fed and cared for. The farmers developed a special interest in their cattle, as is indicated by the fact that numerous livestock shows were held throughout the county. Breed type was emphasized during the period of improvement, and this fact accounts for the uniformity of type of present day Ayrshires.

Ayrshire cattle are uniform in their ability to produce milk and butterfat. While the average production is not as high as Holsteins, many high production records have been made in Canada. The world's champion butterfat producer, Ardgowan Valda, a cow imported into Canada from Scotland, was owned by F. C. Biggs, Dundas, Ontario. Her yearly record was 31,156 lbs. of milk and 1,356 lbs. of butterfat. The average test of Ayrshire milk is 4%. The fat globules are small, and this is regarded as an advantage in cheese making and for infant feeding. Ayrshires have, however, been criticized for their short lactation periods. This is being overcome by better breeding and feeding practices. Breeders claim that their animals are long lived, and lifetime records are encouraged to show how long Ayrshires can produce and reproduce efficiently.

They are of medium size, mature cows weighing between 1,100 and 1,300 lbs., and bulls over 1,650 lbs. In general conformation Ayrshires show a compact body, a strong straight back, good in both shoulder and rump, and with a large barrel. They are lower set than the Holsteins. The udder is usually well proportioned and well attached to the body. Their well balanced form and stylish carriage give them a very attractive appearance. Ayrshire cows in milk when reasonably well fed, carry a fair amount of flesh, but do not appear beefy.

The color of Ayrshires is red and white spotted. The shade of red may vary from cherry to a reddish mahogany. Likewise there is a great deal of variability in the amount of red from an almost solid red to an almost solid white. The lighter colored animals have a slight preference.

They are unsurpassed as grazers on rough sparse pastures. This may be the result of their early environment and active disposition. Ayrshires have splendid apetites and will consume large quantities of roughage. The heavier producing Ayrshire requires a fair amount of grain, but if too heavily fed will often become fat. While the disposition of the cow is good, some Ayrshire bulls are apt to become vicious and hard to manage when not properly handled.

The fact that Ayrshires are hardy and active, with the ability to rustle, makes them adapted to most parts of Alberta. While they have proven more suitable than the other breeds in the rougher and less fertile areas, they have also held their own in the better dairy districts of the province in competition with the other breeds.

The Guernsey Breed

Guernseys were the last of the dairy breeds to be introduced into Canada. They are more popular in eastern Canada

than in the western provinces. The number of these cattle in Canada is increasing rapidly. Guernseys are similar in many ways to Jerseys, having been developed under similar conditions in the Channel Islands. They are a little larger than Jerseys and produce slightly more milk with a little lower test. Their color is also of various shades of fawn, and instead of being mostly solid in color, all carry some white spotting. The Guernsey milk is more highly colored than the milk of any other dairy breeds, and this is due to its higher carotene content. There is a tendency toward some coarseness in body conformation, and the udders are not as well proportioned and attached as are those of the Jerseys. Breeders are striving to correct the faults mentioned, and much improvement has already been accomplished.

The breed is as well adapted to Alberta conditions as is the Jersey, and the successful raising of Guernseys in the province is dependent upon the continued improvement in the existing herds.

Dual Purpose Breeds

While it is admitted that dual purpose cattle are not as efficient producers of milk or beef as the specialized breeds, they may prove particularly useful in areas not suited for specialized dairying. These cattle can be recommended for farms where diversification is an important consideration. Dual purpose cattle are not, however, recommended for areas well suited to specialized dairying, as the lower income that would be secured from milk production would not be offset by the income from beef production.

The Red Poll and the dairy strain of Shorthorns are the two most popular breeds of dual purpose cattle in Alberta. Breeders of such cattle do not strive for as high production records as do breeders of specialized dairy cattle, since by so doing the beef qualities may be lowered. Although the number of purebred cattle of these breeds is relatively small, their beef quality is good, and many commendable production records have been made.

SELECTION OF DAIRY CATTLE

Proper Selection is Very Important.

The proper selection of dairy cows, heifers and bulls is of fundamental importance if the greatest profit in dairying is to be realized. Whether selection is for foundation animals to start a herd, for heifers to replace older or unprofitable cows, or to obtain a suitable bull, the choices made determine to a large extent the degree of success that will be attained in the dairy business.

There are several things necessary in properly selecting dairy animals, namely, an understanding of the ideal type, and ability to interpret and evaluate production records and pedigrees. Furthermore, it is necessary to understand how much importance should be given to each of these items in selecting any one animal.

How to be a Good Judge.

To be a good judge of dairy cattle requires not only a knowledge of what constitutes the ideal type, but also practical experience in handling stock. This experience helps one to observe and understand the degree of relationship that exists between production and conformation.

Knowledge of what constitutes general dairy type, together with the special breed-type standard adopted for each of the dairy breeds can be gained from the livestock journals and other publications, as well as at the livestock fairs. Each breed association has adopted a system of classifying cows according to type. This is not only an aid to selection, but educates the breeder in what constitutes breed type. This system is also used for classifying bulls according to a combined value for type as well as breeding, so that an officially classified bull would be one of suitable type and out of parents of good type and performance.

PRODUCTION RECORDS IMPORTANT IN MAKING SELECTION

Selection can be made more accurate by giving some consideration to production records, as well as to type. This is because production is also an inherited characteristic and thus makes it possible for some cows of good type to be poor producers. Production is quoted in terms of milk as well as butterfat, but before these quantities can be properly evaluated, the conditions under which the records were made are needed. The age of the cow, times-a-day milked, and length of lactation period all affect production and must be considered in determining the producing ability of a cow most accurately.

Pedigree Study Aids Selection.

The consideration of an animal's pedigree also can make selection more accurate. Milk producing ability as well as type is transmitted from one generation to the next.

When the animal to be selected is immature, its ultimate type and producing ability cannot be correctly judged by its appearance, since the animal is not fully developed. Because these characters are transmitted from generation to generation

a knowledge of the type and production of its ancestors can be used as an indication of how the immature animal will develop.

The contribution of any ancestor to the inheritance of an individual is halved for each generation farther removed from the individual being considered. Ancestors three and four generations back on the pedigree contribute comparatively little to an animal's inheritance and therefore should not be given undue consideration. In making selection, therefore, it is most important to find out all one can about the immediate parents of an animal.

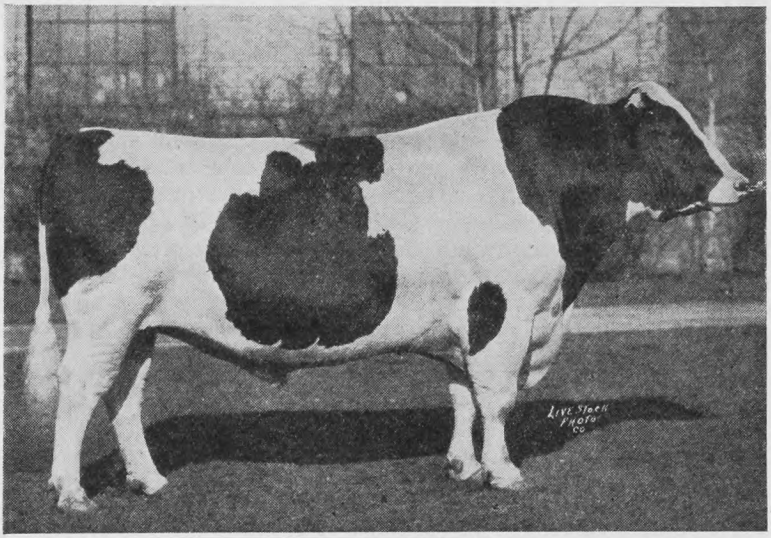


Fig. 5.—Johanna Rag Apple Pabst, an outstanding show bull that has contributed greatly to the improvement of the breed through both sons and daughters.

Pedigree Study Most Important in Selection of Young Animals.

The amount of consideration to give an animal's pedigree and how much to the individual type depends upon its sex, age and the amount of reliable information concerning the ancestors that is known. In selecting a mature cow, her type, mammary development and own performance are accurate indications of what she actually can produce. A further study of her pedigree would, however, give an indication of what inheritance she would transmit to her offspring. In selecting a mature bull, the type and production of his daughters indicates accurately his breeding ability, and is much more reliable than the performance of his ancestors.

Selection should therefore be based upon an individual's type and performance as well as its pedigree. The more accurately one knows about each of these items, the more consideration should be given to it. Increased production, income and profits are dependent on how well the individuals in the herd have been selected.

BREEDING PROBLEMS

Cows that freshen once every year produce more milk during a normal life than those that freshen at any other rate. In well established dairy districts it is desirable to have the cows freshen periodically throughout the year in order that the same quantities of milk can be shipped at all times. On the other hand, in other districts farm or market conditions may be such that it is desirable to have the majority of the cows freshen in the spring or in the fall.

Difficulties are often experienced in successfully breeding cows to freshen at the times planned. The cows either fail to come in heat or fail to become pregnant when bred. The failure of cows to come in heat or to become pregnant may be due to one of many causes, namely (1) diseases of the reproductive organs, (2) nutritional deficiencies, (3) abnormal reproductive organs, and (4) the bull may be an inefficient breeder.

Disease.

Contagious abortion (Bang's disease) and vaginitis are both caused by bacteria that invade the pregnant uterus and cause abortion at any time following service. Retention of afterbirth often leads to infection of the uterus by necrotic bacteria. The infection from this cause may be so great as to make further reproduction impossible. Keeping the cows healthy by proper feeding, care and sanitation prevents breeding difficulties that are caused by disease. (See section on diseases and treatments, page 69 to 84.)

Nutritional Deficiencies.

Cows that are extremely thin due to improper feeding or because of heavy milk flow may fail to come in heat or to become pregnant. Cows must be in good health and thrift if their reproductive organs are to function normally.

When cows appear to be in fair flesh and good health but fail to come in heat or become pregnant, the trouble may be due to some specific vitamin or mineral deficiency. Injections of ascorbic acid (vitamin C) and the feeding of wheat germ oil have cured some nutritional causes of sterility. Lack of minerals such as calcium, phosphorous, iodine, iron and others have reduced the thrift of cows sufficiently to cause sterility.

Cows that are liberally fed good quality hays and grains with iodized salt and a simple mineral supplement should produce calves normally. There is also less possibility of a nutritional deficiency causing poor breeding when cows are on pasture. When cows are being properly fed and yet fail to get with calf, other causes for breeding difficulties should be explored.

Abnormal Reproductive Organs.

The abnormal development of the reproductive organs as well as their reduced or irregular activity may be inherited or may be caused by faulty nutrition. The failure of cows to have normal heat periods regularly, or their failure to conceive or give birth to a normally developed calf may be due to abnormal development or abnormal activity of the reproductive organs.

While nothing can be done to correct inherited abnormalities, improvement can be brought about when the trouble is caused by nutritional deficiencies. Cows in poor health, on account of some debilitating disease, and cows improperly fed sometimes fail to reproduce because a low hormone secretion will not allow the reproductive organs to function normally. Mature cows producing large quantities of milk may so deplete their nutrient reserves that their reproductive organs become inactive, and such cows may fail to come in heat until either milk flow is reduced or until they are fed sufficient of the required nutrients.

The hormones of several of the internal glands control the activity of the different reproductive organs. Breeding difficulties are sometimes caused by failure of these glands to secrete the hormones necessary for the normal functioning of the reproductive organs, and the injection of certain hormones has cured this form of sterility. Cystic ovaries often cause cows to remain in constant heat, and no reproduction is possible until the cysts have erupted or been broken down by mechanical treatment.

Twin calves are believed by some dairymen to be non-breeders when they reach maturity. Scientific studies have proven that it is only the twin heifer of a bull calf that is usually sterile. This is due to the fusion of the embryonic coverings of both calves which allows the blood streams of both to mix. The hormones in the blood of the unborn bull calf prevents female reproductive organs developing in the twin heifer, causing permanent sterility. Such heifer calves should be either vealed or raised for beef, as only about one in twelve is likely to be fertile. When twins are of the same sex their reproductive organs develop normally and their full reproductive ability is attained.

Inefficiency of the Bull.

The failure of cows to become pregnant when conditions for normal reproduction appear satisfactory may be due to the bull being unable to produce normal semen. When a bull develops this inability, most or all of the cows bred to him will fail to get with calf, and will continue to come in season during the following heat periods.

There are many causes for bulls being unable to breed cows successfully. Overwork, lack of exercise, nutritional deficiencies and injuries are a few of the reasons why bulls become poor breeders. Most of these causes can be overcome by proper feeding and management.

Excessive use of the bull reduces the number and vitality of sperm cells. The semen of bulls used too seldom contains many dead sperm cells. Bulls confined to small stalls or kept in small pens without exercise may become slow breeders and may not be able to serve a cow properly.

Nutritional deficiencies may result in numerous breeding ailments of the bull depending on what is lacking in the ration. Feeding bulls too little feed, feeding rations low in proteins or the feeding of large amounts of silage may cause them to be slow and not dependable breeders. Specific mineral and vitamin deficiencies may also cause bulls to develop the same symptoms. The feeding of rations containing some legume hay or protein supplement should help in preventing bulls becoming unsatisfactory breeders. The injection of ascorbic acid and the feeding of wheat germ oil have been used with some success to correct specific deficiencies. Bulls sometimes injure their sex organs in fighting or in breeding cows. This may result in their indifference to the cows they should serve, or by the apparent failure to carry out the complete breeding act.

Artificial Insemination

Artificial insemination offers great promise for rapidly increasing the milk production of cows in subsequent generations. This is based upon the fact that by artificial insemination a superior proven sire can become the sire of thousands of calves, whereas with natural breeding methods a bull is only capable of breeding a few hundred cows during his lifetime. With the greater use of the better bulls, the number of average and inferior bulls can be reduced greatly.

Under artificial insemination, the semen from a bull is collected in an artificial vagina. It is then tested for sperm cell vitality, is diluted, and small portions injected into or near the opening of the cervix of cows in heat. One ejaculate of a bull is often sufficient to inseminate ten to fifteen cows.

Usually the bulls used in organized breeding associations are maintained at a central point where semen is collected and prepared for shipment to official inseminators at distant points.

Breeding cows artificially requires special equipment, and the collection, preparation and insemination of the semen requires technical and sanitary practices. For these reasons, only men specially trained for the work should be employed to perform the necessary operations in artificial breeding on the individual farms. Rules have been adopted by the purebred dairy cattle breeding associations governing the use of artificial insemination in purebred herds.

In addition to the advantages of using better bred bulls, the use of artificial insemination may (1) reduce the number of services for each conception, (2) remove the necessity of keeping bulls for small herds of cows, (3) prevent or keep under control certain diseases, and (4) greatly improve the economic aspects of dairy husbandry through a material increase in milk production.

In order to make artificial insemination available to the livestock breeders, it was necessary that some organization assume the responsibility to properly organize a system for rendering this service.

In 1943 the Alberta Department of Agriculture established a breeding centre at the School of Agriculture at Olds, from which semen of superior bulls can be distributed to breeders of purebred and grade cattle for artificial insemination.

Two Holstein-Friesian bulls of exceptional merit have been purchased in co-operation with the Holstein-Friesian Breeders Association. Rules have been adopted regarding the qualification of purebred females that can be inseminated and nominal fees have been established. Breeders of grade dairy cattle may also have their cows artificially bred by the formation of breeding clubs under the provisions of the Co-operative Associations Act and subject to certain supplementary regulations.

Facilities are therefore available to the breeders of dairy cattle for utilizing artificial insemination and obtaining the benefits of this method of breeding.

FEEDING

Scientists have determined the nutrient requirements of dairy cows and the best means of providing those nutrients. We now know what nutrients the different feeds contain and how much of each the cow can utilize. Feeding trials have shown that when the proper principles of nutrition are applied, the maximum quantity of milk is produced and the feed is used most efficiently. Feeds are known to vary in their

suitability for milk production and, of course, they also vary in price. If dairymen will use the information that is available to them, milk will be more efficiently produced and dairying will become more profitable.

Composition of Feeds

All feeds have been analyzed for the nutrients they contain. It is, therefore, of primary importance in feeding animals to know what nutrients are being fed, both as to kind and quantity. Feeds are analyzed for the following substances:

Moisture.—All feeds contain moisture. Green roughages, roots and the silages may have from 70% to over 90% moisture, while hays and grains vary around 10% depending on the moisture in the air and the length of time the feed is stored. The more moisture a feed contains, the lower will be the proportion of other nutrients.

Protein.—Proteins are complex chemical compounds that are of vital importance in the feeding of dairy cattle because they are most likely to be fed in insufficient amounts. Proteins

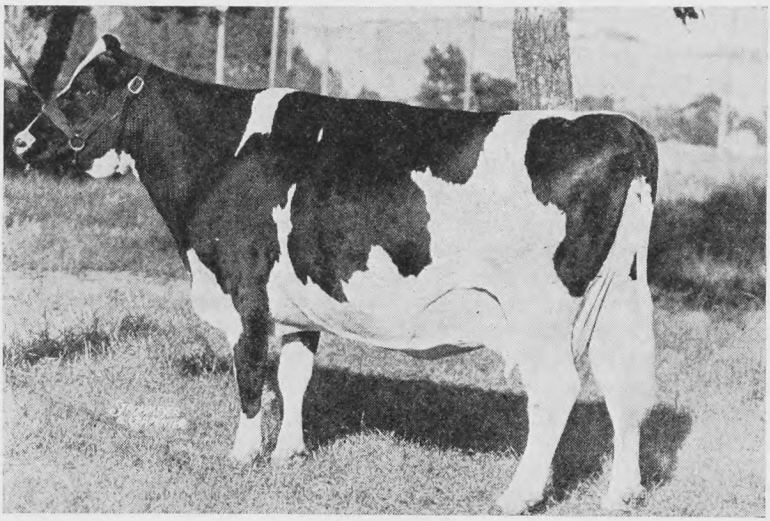


Fig. 6.—A champion Holstein cow, Strathmore Koba Pearl Heilo, bred by C.P.R. Farm, Strathmore, Alberta.

are the only group of common nutrients that contain nitrogen. Feeds containing relatively large amounts of protein are sometimes described as nitrogenous. Milk, alfalfa hay and such feed by-products as linseed meal, wheat bran and shorts contain relatively large amounts of protein.

Crude Fibre.—Crude fibre is the most indigestible part of any feed, and consists largely of celluloses and other similar substances that give rigidity and shape to plants. It is, therefore, high in such material as stalks and stems and lower in leaves and seeds. Feeds low in crude fibre and therefore high in digestible nutrients are called concentrates. Feeds high in fibre and therefore comparatively low in digestible nutrients are called roughages. Grinding roughages does not convert them to concentrates because the crude fibre content remains the same. Roughages with their high crude fibre content give bulk to the ration. In this connection it should be kept in mind that efficient feed utilization by cattle is only attained when there is ample bulk supplied.

Nitrogen-free extract comprises all the readily digestible feed substances other than fats, fibre and protein. Nitrogen-free extract consists largely of starches together with very small amounts of sugar. Feeds that contain relatively large amounts of nitrogen-free extract and smaller amounts of protein are called starchy, or more commonly, carbonaceous feeds.

Fats.—The fats in feeds are largely stored in the germ of the seed as a concentrated form of energy. Feed fats vary in hardness, and may have a definite effect on the quality of butter.

Ash.—When feeds are burned, the ash that remains contains the minerals of the feed. The bones, muscle, blood and milk of animals contain relatively large quantities of minerals. Minerals must be supplied if animals are to grow, reproduce, lactate and remain in good health. Common salt, iodine and calcium, and occasionally phosphorous, are the minerals that are usually not obtained in sufficient quantities from the feed, and therefore must be supplied as supplements.

Function of Feeds

The nutrients in feeds are used (1) to supply energy for the work done by the vital organs of the body, such as the heart, lungs and digestive tract, (2) for the maintenance of body temperature, (3) for the repair of tissues, and (4) for the building of new bone, muscle and fat tissues. In connection with every function of the animal body, specific amounts of the different nutrients are required.

For maintenance alone, the nutrient requirements are chiefly for nitrogen-free extract and fat with very little protein or minerals being required. The bigger the animal, the greater is the nutrient requirement. Exposure to extreme cold increases the requirement. Carbonaceous roughages alone can usually provide sufficient nutrients for maintenance.

Growth and pregnancy involve a building up of flesh and bone that is largely composed of protein and mineral. The faster an animal grows, the greater will be the need for protein and mineral supplements. Newborn calves grow very rapidly, and as they become older their growth rate decreases, reducing their need for protein and minerals. Pregnant cows, therefore, require a little more feed than for maintenance alone.

Fattening requires a surplus of feed above other requirements. A dairy cow that fattens while producing milk is either getting too much feed or is using feed for body fat rather than for milk production. Fattening cows prior to freshening is sometimes practiced to increase milk production during the following lactation period. Thin cows may be fattened during their dry period by feeding an excess of carbonaceous or starchy feeds. Very little protein or minerals are required in this process.

Milk secretion calls for relatively large quantities of protein and minerals in the feed. Some cows have difficulty in eating and digesting sufficient feed to meet their requirements for milk secretion, because the inherent ability to produce milk has been increased to such high levels. So great is the nutrient requirement for heavy milk production that only by careful planning will the ration provide the cows with the right amount of the required nutrients. A deficiency of any one nutrient will ultimately reduce milk production to the level at which that nutrient has been used up. Feeding lactating cows a ration containing a variety of palatable feeds reduces the possibility of certain deficiencies developing. The liberal feeding of a varied ration containing sufficient protein and minerals is essential for maximum milk production.

The rations for immature cows should contain the combined nutrients required for maintenance, growth, pregnancy, as well as for milk production, because they are still growing and are rebred while still lactating.

Cows producing 25 lbs. of 4% milk require almost twice as much feed as dry cows to meet their nutrient requirements. This extra feed for milk production must be provided chiefly in the form of a concentrate mixture, because cows cannot consume unlimited amounts of roughage.

Nutritional Value of Feeds

The nutritional value of a feed is based upon how well it satisfies the nutrient requirements of an animal. A chemical analysis of a feed shows the percentage content of the various nutrients, but does not show how much of these are digestible. Neither does it show a feed's palatability, vitamin or mineral

content, or the presence of injurious substances. Nevertheless, the chemical analysis is used by law as a basis of commercial feed evaluation. The Feeding Stuffs Act provides that all commercial feed mixtures and feed by-products offered for sale shall be accompanied by a statement guaranteeing that the crude fibre is not greater than the percentage stated, and that the crude protein contents are not less than the percentage stated. Knowing the fibre content enables one to understand approximately how much of the feed is indigestible, and a knowledge of the protein content is likewise important because it cannot be replaced by either carbohydrates or fat. The Act also provides that a statement be given guaranteeing a minimum percentage of fat for most feeds. Since excess fat is not desirable, commercial feeds that tend to be over 7% fat must be labeled with a statement showing the maximum fat content.

The nutritional value of a feed is more accurately calculated by determining the quantity of the various nutrients that are digestible. Numerous digestion trials have been conducted with cattle fed the various kinds of feeds. The average digestible protein and total digestible nutrient content in 100 pounds of feed show in Table I is based upon the results of these trials. The table also shows the ratio of digestible protein to the other digestible nutrients to indicate the relative proportion of digestible protein in each feed.

The calculating of balanced rations is largely based upon the digestible nutrients content of feeds.

TABLE I.

Average Percentage of Digestible Nutrients in Feeding Stuffs*

Feeding Stuff	Total Dry Matter %	Dig. Protein %	Total Dig. Nutrients %	Nutritive Ratio 1:
Dry Roughage:				
Alfalfa hay, all analyses	90.4	10.6	50.3	3.7
Alfalfa hay, fair	90.4	9.6	49.8	4.2
Alfalfa meal, good	91.9	10.8	53.9	4.0
Barley hay	91.9	4.9	54.1	10.0
Barley straw	90.0	0.9	44.5	48.4
Bromegrass hay, all analyses	88.1	5.0	48.9	8.8
Clover hay, alsike all analyses	89.0	7.7	49.0	5.4
Clover hay, Altaswede	88.0	6.9	51.7	6.5
Clover hay, sweet, 2nd year	92.0	10.5	49.9	3.8
Clover and timothy hay, all analyses	88.0	4.4	48.0	9.9
Oat hay	88.0	4.5	46.3	9.3
Oat straw	89.6	0.9	44.1	48.0
Prairie hay, western, good quality	90.4	2.6	49.2	17.9
Red top hay, all analyses	91.0	4.5	53.6	10.9
Reed canary grass hay	90.8	3.5	46.6	12.3
Timothy hay, before bloom	88.7	5.6	50.2	8.0
Timothy hay, full bloom	88.7	3.2	48.0	14.0
Wheat straw	90.1	0.8	35.7	43.6
Wheat grass hay, crested	87.9	6.9	50.3	6.3
Roots and Tubers:				
Potatoes	21.2	1.1	17.3	14.7
Turnips	9.5	1.3	8.5	5.5
Silages				
Oat	28.3	1.1	15.4	13.0
Sunflower	22.2	1.1	12.6	10.5
Concentrates:				
Barley, common	90.4	9.3	78.7	7.5
Beet pulp, dried	92.0	4.8	71.8	14.0
Beet pulp, wet	11.6	0.8	8.9	10.1
Brewers' grains, wet	23.9	4.6	16.6	2.6
Flaxseed	93.6	21.4	108.7	4.1
Linseed meal, old process, all analyses	91.3	30.6	78.2	1.6
Meat meal or tankage, 60% protein	92.2	56.4	78.0	0.4
Molasses, beet	80.6	2.5	58.8	22.5
Oats	91.1	9.4	71.5	6.6
Skimmilk, centrifugal	9.6	3.5	8.6	1.5
Wheat, recent analyses	89.8	11.3	83.6	6.4
Wheat bran, all analyses	90.6	13.1	70.2	4.4
Wheat screenings	90.4	9.7	64.0	5.6
Wheat standard middlings, all analyses	90.0	14.4	78.4	4.4

*Taken by special permission of the Morrison Publishing Co., Ithaca, New York, from the extensive data in "Feeds and Feeding," 20th Edition, by F. B. Morrison.

What is a Suitable Ration?

Not all rations calculated to meet the protein and energy requirements are suitable. They may be deficient in other nutrients, may provide insufficient bulk, or cows may refuse to eat the ration. A good deal of thought has to be given to the choice of feeds that are to be included in the ration to make it suitable.

Rations to be suitable must contain:

1. Sufficient protein and digestible nutrients to meet requirements.
2. A variety of feeds, so that protein, mineral and vitamin deficiencies of one will offset the deficiencies of another.

3. Feeds that are palatable so the animals will consume their fully daily allowance.
4. Sufficient bulk to maintain efficiency of digestion.
5. Feeds that supply the required nutrients at a low cost.

Rations should also be slightly laxative.

Suggested Concentrate Mixtures.

Herd concentrate mixtures will be largely determined by the roughages which are being fed and also by the concentrate feeds available. Sample herd concentrate mixtures that will meet the requirements of dairy cows on different kinds of hay are shown in the following table.

TABLE II.

Suggested Herd Concentrate Mixtures

	Mixture No.				
A.—For cows fed only grass or cereal hays:	1 lbs.	2 lbs.	3 lbs.	4 lbs.	5 lbs.
Oats	585	725	625	550	560
Barley	.....	.....	.....	170	280
Wheat	.....	.....	100	.....	.....
Wheat Screenings	240	.....	.....	.....	.....
Wheat Bran	.....	100	.....	100	72
Shorts	.....	.....	100	.....	.....
Linseed Meal	175	175	175	180	.....
Meat Scraps	.....	.....	.....	.....	88
	1,000	1,000	1,000	1,000	1,000
B.—For cows fed roughages composed of about one-third alfalfa and two-thirds grass or cereal hays:	6 lbs.	7 lbs.	8 lbs.	9 lbs.	10 lbs.
Oats	560	900	660	650	765
Barley	280	.....	190	190	.....
Wheat	.....	.....	.....	.....	215
Wheat Screenings	135	.....	.....	.....	.....
Wheat Bran	.....	110	.....	160	.....
Shorts	.....	.....	150	.....	.....
Linseed Meal	25	.....	.....	.....	20
	1,000	1,000	1,000	1,000	1,000
C.—For cows fed roughages composed of about two-thirds alfalfa and one-third grass or cereal hays:	11 lbs.	12 lbs.	13 lbs.	14 lbs.	15 lbs.
Oats	900	800	800	700	700
Barley	.....	150	100	290	100
Wheat	100	.....	100	.....	.....
Wheat Screenings	.....	.....	.....	.....	200
Wheat Bran	.....	50	.....	.....	.....
Linseed Meal	.....	.....	.....	10	.....
	1,000	1,000	1,000	1,000	1,000

Thumb Rules for Feeding.

For roughage.—On the average, cows will consume at least 2 lbs. of roughage daily for each 100 lbs. live weight. They will eat more roughage when it is of good quality and palatable. The more roughage of good quality cows will eat, the less of the concentrate mixture will be required. While full

feeding of hay is recommended, cows are unable to eat much over 2½ lbs. daily for each 100 lbs. live weight when no grain is fed or much over 2 lbs. when grain is heavily fed. Silage can replace hay at the rate of 3 lbs. for each pound of hay.

For concentrates.—There are three separate rules that can be used as guides for the feeding of concentrates:

1. Feed 1 lb. concentrates daily for each 3 to 4 lbs. of milk, depending upon the test of the milk. For cows producing milk under 4% butterfat, 1 lb. of concentrates for each 4 lbs. of milk is usually sufficient.
2. Feed 1 lb. concentrates daily for each pound of butterfat produced in a week. While this method is a little more accurate, it necessitates periodic testing of the milk to enable calculation of the weekly butterfat production.
3. Feed concentrates according to a plan which takes into account the quality and amount of hay fed as well as the test of the milk produced, as is shown in the following table.

TABLE IIIa

Grain Feeding Table for Cows Not on Pasture*

Hay equivalent consumed per 100 lbs. of live weight daily			Total pounds of grain or concentrates to feed					
2½ lbs. very liberal feeding of good roughage	2 lbs. usual rate of feeding good hay or good hay and silage	1½ lbs. feeding scanty amt. of good roughage or feeding poor roughage	% of fat in milk					
Milk produced daily, pounds			3.5%	4.0%	4.5%	5.0%	5.5%	6.0%
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
17	10	....	.....	.....	1.9	2.2	3.1	3.5
21	14	....	2.0	2.4	3.8	4.2	5.3	5.7
25	18	11	3.6	4.2	5.6	6.2	7.4	8.0
29	22	15	5.2	5.9	7.5	8.2	9.5	10.2
33	26	19	6.8	7.6	9.3	10.2	11.6	12.5
37	30	23	8.4	9.3	11.2	12.2	13.7	14.7
41	34	27	10.0	11.1	13.1	14.2	15.8	17.0
45	38	31	11.6	12.8	14.9	16.1	18.0	19.2
49	42	35	13.2	14.5	16.8	18.1	20.1	21.5
53	46	39	14.8	16.3	18.7	20.1	22.2	23.7
57	50	43	16.4	18.0	20.5	22.1	.....	.....
61	54	47	18.0	19.7	22.4	.....	.....	.....
65	58	51	19.6	21.4	24.2	.....	.....	.....
69	62	55	21.2	23.2	.....	.....	.....	.....
73	66	59	22.8	24.9	.....	.....	.....	.....

Regardless of the amount of grain theoretically required by a cow, she should not be fed more than she can safely handle.

Example: a cow receiving the usual allowance of good hay and producing 30 pounds of 4.5% milk should be fed 11.2 pounds of concentrates daily.

*Taken by special permission of the Morrison Publishing Co., Ithaca, New York, from the extensive data in "Feeds and Feeding," 20th Edition, by F. B. Morrison.

TABLE IIIb

Grain Feeding Table for Cows on Pasture*

Quality of Pasture								
Excellent	Good	Fair	Total pounds of grain or concentrates to feed					
Milk produced daily			% of fat in milk					
lbs.	lbs.	lbs.	3.5%	4.0%	4.5%	5.0%	5.5%	6.0%
22	13	....	....	....	....	....	....	1.2
26	17	....	....	....	1.9	2.2	3.1	3.5
30	21	12	2.0	2.4	3.8	4.2	5.3	5.7
34	25	16	3.6	4.2	5.6	6.2	7.4	8.0
38	29	20	5.2	5.9	7.5	8.2	9.5	10.2
42	33	24	6.8	7.6	9.3	10.2	11.6	12.5
46	37	28	8.4	9.3	11.2	12.2	13.7	14.7
50	41	32	10.0	11.1	13.1	14.2	15.8	17.0
54	45	36	11.6	12.8	14.9	16.1	18.0	19.2
58	49	40	13.2	14.5	16.8	18.1	20.1	21.5
62	53	44	14.8	16.3	18.7	20.1	22.2	23.7
66	57	48	16.4	18.0	20.5	22.1	....	....
70	61	52	18.0	19.7	22.4	....	....	....
74	65	56	19.6	21.4	....	....	....	....

Regardless of the amount of grain theoretically required by a cow, she should not be fed more than she can safely handle.

Example: a cow on excellent pasture and producing 30 pounds of 4.5% milk should receive 3.8 pounds concentrates daily.

*Taken by special permission of the Morrison Publishing Co., Ithaca, New York, from the extensive data in "Feeds and Feeding," 20th Edition, by F. B. Morrison.

Roughages

Comparing pasture, hays and grain, pasture is the cheapest source of the required nutrients, followed by the hays and lastly the grains. The districts best adapted to dairying are those which can produce an abundance of crops suitable for pasture or hay. It follows that cows which consume large quantities of hay will be the most economical producers. Hay crops should therefore be given more consideration than grain crops in planning the feed supply for dairy cows. Cows in milk should be fed all the hay they will consume without undue waste and take sufficient of a concentrate mixture to provide the balance of the nutrient required.

Hays Vary in Composition.

Hay when cut at the immature stage contains larger amounts of protein than when more mature. It is also less coarse and is more palatable. It is therefore advisable to cut hays before the crop becomes too ripe, coarse and unpalatable.

The curing of hays affects its feeding value. Too much exposure to sun, leaching by rain, or spoilage by dampness in storage may reduce its value as a feed by as much as one-third.

Legume hays, grass hays and cereal hays differ in their nutrient content. Legume hays are richer in protein and minerals than grass hays. Cereal hays contain the least calcium (lime) and cereal straws are too low in feed value for use in rations of cows in milk. Dairymen should therefore strive

to grow the most nutritive hays and to prevent any loss of nutrients during the curing process.

Legume Hays Are the Best.

As a group, legume hays normally contain more protein and minerals than other hays. They are more palatable, and in addition help to maintain soil fertility and prevent soil erosion.

Alfalfa is recommended as the best of all hays for the feeding of dairy cattle. The high protein and calcium content of alfalfa hay decreases the necessity of feeding the higher priced protein and calcium supplements. When alfalfa of good quality comprises one-half of the roughage, it will provide sufficient protein even in the case of high producing cows. In feeding practice this would mean that the linseed meal and bran could be eliminated from the concentrate mixture.

Alfalfa hay should be reserved for cows producing the most milk, because the nutrient requirement of dry and low producing cows can be obtained from the less nutritious roughages.

Alfalfa is adapted to a wide range of soil types, but it does not thrive on poorly drained soil, nor in soil that does not contain a fair amount of lime. Alfalfa requires a reasonable amount of moisture, and should be grown where there is a fair amount of precipitation or on irrigated land where soil moisture can be regulated. Good yields are secured in years of favorable rainfall, and two crops can usually be cut. The first cutting is usually coarser and less nutritious than the second cutting, and contains a lesser amount of digestible crude protein and total digestible nutrients.

Sweet clover is similar in composition to alfalfa, but it makes a much coarser and less palatable hay. Nevertheless, by early cutting and careful curing a good, very suitable hay crop can be produced. Sweet clover is adapted to drier conditions than alfalfa or other legume hay crops. It is a biennial, being used as a cover crop the year of seeding and a hay or pasture crop the following year.

Red clover (Altaswede) is very palatable and relished by dairy cattle of all ages. While it contains only two-thirds the digestible crude protein of alfalfa, it is just as rich in total digestible nutrients. Altaswede clover requires a soil which is well drained, free from alkali, and not too strongly acid. It is adapted to the black and woodland soils, and to the irrigated sections. The Altaswede variety is a perennial, whereas other varieties of red clover are biennials.

Alsike clover is similar to red clover in feeding value, but is not quite as palatable. It is adapted to quite moist conditions, and consequently grows well, especially in gray wood-

land soils and adjacent black soil areas. It will thrive well on the heavier soils and on lighter soils if the moisture conditions are adequate and if sufficient lime is present.

Perennial Grass Hays

The grass hays most common in Alberta are timothy, brome grass, crested wheat grass, red top, upland prairie, slender wheatgrass (Western rye), and Reed canary grass. These hays vary in composition, palatability and other characteristics, thus making them differ in their suitability for dairy cattle. All grass hays vary greatly in composition according to the stage of maturity at which they are cut. This affects their value in dairy cattle feeding. Each of these is adapted to a particular set of conditions, moisture supply being the chief factor which determines the localities in which they will thrive.

Timothy hay, providing it is cut before it reaches the full bloom stage, and is properly cured, can be satisfactorily fed to dairy cattle. It grows best in parts of the province where moisture conditions are good, and on irrigated land. It thrives better on cold wet soils of the heavy types than some of the other grasses, and although it endures considerable drought, it yields poorly under dry conditions. Timothy hay cut before bloom contains about 70% more protein than when cut in full bloom. For dairy cattle feeding it is advisable to cut timothy hay prior to full bloom in order to preserve a larger proportion of its protein as well as its palatability.

Brome grass is one of the more common crops grown for hay and pasture. It is a fairly nutritious hay when cut before becoming coarse and unpalatable and when well cured. Brome is extremely winter hardy and usually yields well. Because brome becomes sodbound, it is not advisable to use it as a hay or pasture crop for too long a time.

Slender wheatgrass (western rye) is a native type of bunch grass that makes a fairly nutritious hay for dairy cattle. It is winter hardy and grows wild under limited moisture conditions. Because it is subject to certain root rot to which the wheat plant also is susceptible, it should be seeded in a rotation which will not jeopardize a subsequent wheat crop.

Crested wheat grass hay is more suitable for the drier districts in the province. It is fairly nutritious and well liked by dairy cattle. Although it can be grown in central and northern Alberta where moisture is more plentiful, other better yielding and more palatable hays should be grown in areas of good rainfall.

Red Top hay is as nutritious as most other grass hays, but lacks somewhat in palatability. It grows well in marshy and

moist soils and will grow on soils too acid for most other grasses. It is hardy and will withstand considerable drought. While these facts may favor the growing of red top in certain districts, the growing and feeding of this hay crop is not recommended for dairy cows when other more suitable hays are available.

Upland Prairie hay of good quality for feeding dairy cattle is becoming less plentiful. The best and most nutritious prairie hay consists wholly of the finer grasses, cut green and well cured, containing little or none of the coarser slough grasses or dead remains of previous years' growth. The lower grades of prairie hay are extremely low in feeding value and cannot be recommended as a suitable hay for dairy cows.

Reed canary grass is coarse, unpalatable and lacking in feed value. When fed to cows in heavy production, an extra allowance of grain should be fed to offset the lower nutritive value of this hay. This grass can be grown in low lying areas that are subject to periodic flooding.

Annual Grass Hays

These include the cereal hays such as oat, barley, wheat and rye hays. Early cut cereal hays are relished by cattle. As the crop ripens, the straw becomes coarse, unpalatable, and less digestible. Dairy cows should not be forced to consume the ripened butts of these hays unless hay is extremely scarce. Cereal hays are low in calcium, and mineral supplements should be fed when these hays are the sole roughage. They vary greatly in palatability and nutritive value, depending on the stage of maturity when cut. Cereal hays are usually grown when insufficient quantities of legume or perennial grass hays are available.

Oat (greenfeed) hay is the most commonly grown cereal for hay in central and northern Alberta. The yields are usually good, and when cut early it is relished by dairy cattle. Experiments conducted at the University of Alberta comparing an oat hay-grain-protein supplement ration with an alfalfa-grain ration without protein supplements proved that while milk production could be maintained almost as well with the oat hay ration, the cost of the protein supplements increased the cost above that of the alfalfa hay ration. Oat hay proved to be worth not more than 60% as much as alfalfa for cows producing over 35 lbs. of milk daily. Had the protein supplements not been added to the oat hay ration, the value of oat hay would have been less.

The cutting of oat hay when still green or cut not later than the early milk stage is recommended for dairy cows in milk,

whereas oat hay cut when more mature is more suitable for dry cows.

Barley hay is likewise a palatable and nutritious cereal hay when it is cut green and well cured. There is some objection to the awns which become increasingly detrimental as the barley crop ripens. Awnless barley is a much more suitable hay crop to grow, and is increasing in popularity. Barley hay, while not yielding quite as well as oat hay, is slightly higher in digestible protein and total digestible nutrients.

Cereal Straws

Cereal straws are not recommended for dairy cows in milk as they are less palatable and much lower in feed value than any of the hays. They may be used to a limited extent for dry cows and heifers if a suitable concentrate mixture is fed to keep them in a fair condition of flesh.

Oat and barley straws are the best of the cereal straws. Where there is a shortage of other hays these straws may be fed in limited amounts providing additional grain is fed to offset the deficiencies of the straw. Awned barley straw should not be fed as the awns are likely to cause sore mouths. The awnless barley straw is a much safer feed.

Wheat and rye straws are the least palatable and lowest in feed value of all straws, and are therefore not recommended as a feed for dairy cattle.

Mixed hay crops are desirable.

The feeding of more than one hay adds variety to the ration and often provides a more suitable supply of feed nutrients. The seeding of mixed hay crops results in greater yields than the growing of separate hay crops, and is a much simpler way of feeding a variety of hays. In these mixed crops it is desirable that at least one grass and one legume be grown, the kinds being carefully chosen to suit the climatic and soil conditions. Often a simple mixture of brome and alfalfa has proven to be a good mixture either for hay or for pasture.

Root crops and tubers.

Succulent feeds are very palatable and suitable for dairy cattle feeding. Because the cost of producing these crops is relatively high, they are very seldom grown as a crop for the dairy herd except for cows on test, or fitting animals for showing. Occasionally, however, due to a low market price, or danger of spoilage, such crops can form an important part of the dairy cow ration.

Silages.

Silages are also succulent feeds that are highly desirable for dairy cows during the winter. Silage feeding offers several advantages. Green crops can be stored in a silo in a smaller space and with less loss in feed value than the same crop cured as hay. Weedy crops can be best utilized as ensilage. Under average farm feeding conditions, the addition of ensilage to an otherwise dry ration will usually increase production. However, recent experiments have shown that when a suitable balanced ration is being fed, and when water is available at all times, the addition of ensilage to the ration will produce very little or no increase in production.

Considerable study is now being given to the ensiling of green grasses and legumes to avoid difficulties in properly curing these crops as hay. Excellent grass and legume silages have been produced when certain acids or molasses have been added to the crop at the time of ensiling. It has been found that the superior nutritive qualities of legumes is not lost during ensiling, and cows fed these silages produce milk of higher vitamin content.

The present conditions on the average dairy farm of the province are such that feeding ensilage is of questionable economic importance. There are, however, dairy farms, especially near the larger urban centres, where the growing of crops for ensilage may be recommended as a method of increasing production and decreasing costs.

Oat silage.—Where corn cannot be grown for silage, oats can be used to advantage. It is the most nutritious and most suitable silage for most parts of Alberta. It is palatable and mature cows will readily consume from 30 to 40 lbs. per day. Freezing in an upright silo does not make its removal from the silo more difficult. The oat crop is usually cut in the early dough stage, and when ensiled at this stage of maturity will usually make good quality ensilage. However, if cut at an earlier stage, or if it contains a large quantity of weeds, ensilage that is high in acetic acid, that is, acrid or putrid, may develop. Such undesirable silage can be avoided by the addition of 20 to 30 lbs. of molasses per ton of oats when being cut into the silo.

Sunflower silage is a less desirable ensilage, even though heavier yields can be grown per acre. It is a palatable silage which usually contains a little more moisture than oat silage. Experiments conducted at the University of Alberta have shown that on a dry matter basis, the nutritive values of these two ensilages are equal. An objection to sunflower ensilage lies in the difficulty in using the silage after it has been frozen

in an upright silo. It is not only difficult to remove the frozen silage from the silo, but such ensilage requires several days to thaw out at barn temperature. Such difficulties can be overcome by ensiling in a trench or pit silo.

Concentrates

It is impossible for cows producing over 15 or 20 lbs. of milk per day to satisfy their nutrient requirement from hay alone, or from a mixture of hay and silage. Such animals must receive additional nourishment in concentrated form from feeds having a low fibre content and high nutritive value. This concentrate feed must also provide the nutrients which may be lacking in the roughage so that the entire ration satisfies all the nutritional requirements of the animals. While the cereal grains usually comprise the major part of the concentrate mixture, the addition of protein rich feed by-products, together with certain minerals, is often required to provide a properly balanced ration.

The different grains and feed by-products vary greatly in composition, palability and in their usefulness for milk production, growth and fattening. A brief comment on a few of the concentrate feeds follows.

Cereal Grains.

All the cereal grains are slightly carbonaceous and the addition of some protein supplement is necessary when grass or cereal hays are being fed. The grains are low in calcium, and for this reason mineral supplements are usually fed to the heavy producing cows. The grains should be coarsely ground or crushed.

Oats is the most desirable of all the grains for dairy cattle of all ages. It is very palatable and usually contains a larger proportion of digestible protein than the other cereal grains. It should comprise the main part of all concentrate mixtures for growing heifers as well as cows in milk.

Barley is a very suitable grain for dairy cattle feeding. It is palatable and usually contains slightly more total feed nutrients than oats and is slightly more carbonaceous. Barley is a heavier grain and tends to be fattening when fed in too large a quantity. However, when fed with suitable other feeds it has proven to be quite satisfactory for cows in milk.

Wheat is not as suitable as oats or barley for feeding cows in milk. It is still less suitable as a feed for young stock. Wheat is much heavier and may cause digestive disorders. Nevertheless, it has been fed successfully as the sole concentrate by some dairymen to cows of average production. In experiments at the University of Alberta, concentrate mixtures containing

60% wheat have proven as good as concentrate mixtures containing no wheat. In these experiments, however, the heavy wheat ration was fed with the silage to offset the undesirable properties of wheat. The mixing of other light concentrates or chopped hay with the wheat has the same effect. Usually the price of wheat is high compared to the other grains, in which case its feeding is an uneconomical practice.

Rye is the least suitable of the cereal grains for dairy cattle. While its nutritive value may be equal to or better than the other grains, it is less palatable, and cows requiring a heavy grain allowance may refuse to consume sufficient quantities if the proportion of rye is too large.

By-product concentrates.

These vary greatly in composition and suitability. Some are rich in protein and are most useful as a supplement to carbonaceous feeds. Other by-products are carbonaceous and have to be fed with protein rich feeds. None of the following feeds are used as the sole concentrate, but only form a part of the concentrate mixture. Because the by-products vary in price, their purchase should be based largely upon their composition and feed value.

Beet pulp is a carbonaceous by-product of the sugar beet refineries. It is a bulky, succulent feed containing a fair amount of fibre. It is slightly laxative and has the effect of maintaining the appetite of heavily fed test cows. Dry beet pulp is equal in feed value to oats.

Wet Brewers' Grains is a protein rich succulent by-product and is well liked by dairy cows. It is a fairly bulky feed containing slightly more fibre than most concentrates. On a dry basis, brewers' grains contain less digestible nutrients than oats. It may be fed up to 40 lbs. daily. Special arrangements have to be made on the farm for storing and feeding brewers' grains, as it may become sour during warm weather when stored too long. Brewers' grains have proven to be a cheap protein rich feed for dairymen located reasonably close to breweries.

Flaxseed is grown chiefly for the linseed oil it contains. After the oil has been extracted, the residue is available as linseed meal, which contains approximately 50% more digestible protein than flaxseed. Flaxseed is, therefore, less valuable as a protein supplement than linseed meal. Flaxseed meal is most valuable when fed to young stock to promote normal growth and thrift. It has a laxative effect and acts as an aid to digestion. Because it has the effect of adding a sleekness and bloom to the appearance of animals, flaxseed meal is used by breeders of purebred stock, and by showmen

for these special properties rather than for its nutritive value. In years of normal feed prices, flaxseed meal is usually more expensive than linseed meal, and dairymen would be advised to sell their flax and purchase the linseed meal derived from it.

Linseed meal—the by-product of flaxseed after the oil has been extracted—is one of the most suitable protein rich supplements for milk production. As previously mentioned, it contains about 50% more digestible protein than flax and over three times the protein of oats or barley. Linseed meal is palatable and has a desirable laxative effect, which helps in maintaining the animals in good thrift.

Meat meal or meat scraps is similar to digester tankage except that it is higher in protein and does not have as strong an odor. It is the richest protein supplement used in dairy cattle feeding, and therefore less is required to balance carbonaceous feeds. Cows usually do not like meat scraps at first, but if small quantities are fed, the amounts can be increased to the full allowance desired. Certain batches of meat scraps may prove more unpalatable than others.

Beet molasses is definitely a carbonaceous feed, a by-product of sugar beet refineries. Its feeding value is dependent upon its sugar content, which makes beet molasses a very palatable feed. Experiments have shown that, pound for pound, it is worth 80% as much as oats in nutritive value. This figure can be used to calculate how much one can afford to pay for molasses as a feed. Sometimes it is used to increase the consumption of less palatable feeds. In such cases molasses is diluted with two parts of water and poured over the unpalatable feed, usually a roughage. Molasses has proven to be a cheap feed in areas surrounding a sugar refinery, but freight charges to distant points may increase the total costs to such an extent as to make its use uneconomical.

Wheat bran is probably the most widely used protein rich supplement in dairy cattle feeding. While it only contains about 43% as much protein as linseed meal, wheat bran has proven of special value for purposes other than its protein content. It is especially useful in lightening concentrate mixtures and during periods when there is danger of digestive disorders. The feeding of warm bran mashes before and after calving is highly recommended for maintaining health during this critical period. Wheat bran appears to have the effect of stimulating milk secretion and possesses a higher feeding value than is indicated by its digestible nutrient content. It contains large amounts of phosphorous and vitamins that are required by both growing and lactating animals. Wheat bran is also an excellent feed for calves and heifers.

Recleaned wheat screenings as sold in Canada under the Grain Inspection Act is classified in two grades—No. 1 containing no more than a total of 6% and No. 2 no more than 10% total weed seeds, and neither grade containing sufficient weeds of the kind that may be injurious to livestock. Its feeding value is determined largely by its weight per bushel—the better grades would compare favorably with barley and wheat in feeding value. Screenings should be ground finely enough to kill all weed seeds. Wheat screenings, when available, can usually be purchased at prices which make them a cheap source of nutrients for feeding dairy cows.

Uncleaned wheat screenings vary in composition and in feeding value according to the maturity of the wheat kernels as well as to the amount of chaff and other material present. The fact that these screenings may contain large quantities of weed seeds of various kinds may mean that such screenings may be unpalatable. Screenings that are fairly light in weight have a low feeding value but can be satisfactorily fed to young stock and dry cows. These screenings can also be used to lighten an otherwise heavy concentrate mixture.

Wheat standard middlings or shorts are suitable dairy cattle feeds if not forming too large a part of the concentrate mixture. While these feeds contain fair amounts of protein, experiments have shown that they are not as suitable as wheat bran for feeding cows in milk. Wheat middlings or shorts are much heavier than bran, and should not be used in an otherwise heavy concentrate mixture. When prices for these by-products are below the price of bran, they can be used in small amounts to cheapen the cost of the ration.

Commercial Protein and Mineral Supplements

During the past few years there has been a considerable increase in the sale of commercial mixed feeds in the western provinces. These feeds usually contain a variety of feed by-products that are often unavailable to dairymen in small quantities. Because coarse grains are readily available on most farms, dairymen prefer to purchase protein and mineral supplement mixtures that can be mixed with a prescribed quantity of ground coarse grains.

The value of such protein and mineral supplements to the dairymen is dependent largely upon the amount and kind of protein and mineral supplements they contain. Supplements with the higher protein content are worth more than those with less protein because more of the coarse grains can be added to obtain the desired mixture for feeding the herd. A comparison of costs between a home-mixed concentrate and one using a commercial protein and mineral supplement as pre-

scribed by the manufacturer could be made by comparing the cost of a 1,000 lb. mixture in Table II with a 1,000 lb. mixture using the commercial feed.

When alfalfa hay is available there is less need for the protein and mineral supplements, and it may be to the advantage of dairymen to make their own concentrate mixtures if the required feeds are available.

All commercial feeds are sold under Dominion Feeding Stuffs Act which requires all sacks of commercial feed to show a guaranteed analysis and a list of the ingredients.

Minerals for Dairy Cattle

During the past decade considerable scientific information has been secured on the mineral requirements of dairy cows. In addition, numerous experiments have been conducted to determine the practical advantages of feeding mineral supplements. Commercial feed companies are offering for sale numerous kinds of mineral supplements that vary widely in suitability and price. There are a few that contain certain minerals that are not likely to be deficient in rations for dairy cattle.

A good dairy cow requires relatively large quantities of minerals to satisfy the combined needs for milk production, growth, reproduction and maintenance. When rations containing a fair variety of feeds are fed, there are only four minerals that are likely to be deficient, i.e. common salt, iodine, calcium (lime), and phosphorous. There is very little possibility of other minerals being lacking except under very unusual feed conditions.

Common salt (sodium chloride).—The feeds commonly used in dairy rations do not contain salt, and for this reason it has to be fed to all animals. It is a mineral that can be self fed without danger of overfeeding, but certain cows occasionally may not eat sufficient to take care of their requirement. It is, therefore, a good practice to add 1 lb. of salt to each 100 lbs. of the concentrate mixture. This insures that the heavy producing cows with the highest salt requirement will consume the most salt. Even when salt is fed with grain at this rate, additional amounts should be made available by allowing the cattle access to either a box of loose salt or to block salt.

Iodine may also be lacking in dairy rations. Serious losses due to iodine deficiency have occurred among newborn animals in most parts of Alberta. In dairy cattle iodine deficiency is indicated generally by the birth of calves that show one or more of the following symptoms—soft and flabby, goitred (big neck) and partially hairless. In many cases the calf is born dead or dies within a few days of birth.

Iodine is usually supplied in the form of potassium iodide. A convenient method of feeding the iodide is to mix 3 oz. of potassium iodide with each 100 lbs. of salt. This is a good salt mixture to use with the grain as suggested previously. Iodized block salt usually contains less iodine and is best used as a supplement to the iodized salt fed in the grain mixture. Formerly iodized salt blocks lost most of their iodine on storage, but recent improvements in method of manufacture makes it less likely that the iodine will be lost.

Calcium (lime) is only lacking in certain kinds of rations and in cows producing the larger amounts of milk. The rations most likely to lack calcium are those containing no legume hay such as alfalfa or clover. The grass hays and especially the cereal hays are fairly low in calcium, and the cereal grains that comprise the major portion of our concentrate mixtures are very low in this mineral.

Cows producing small quantities of milk can secure enough calcium from non-leguminous rations to meet their requirements. Heavy producing cows require more calcium than that contained in the average non-leguminous rations. It is true that animals store calcium in their bones and can use a large proportion of it to carry them over short periods of calcium shortages. It is, however, not good practice to force cows to use their bone calcium, as serious consequences may follow if too much is taken from their bones.

The best practice is to make certain that cows get sufficient calcium in their rations. The cheapest and surest way is to feed legume hays, as these contain ample calcium for the needs of all cows even if legumes comprise only half the roughage allowance.

When legume hays are not fed, a dairyman has the choice of feeding slaked lime, limestone, bonemeal or mono-calcium phosphhate (Animal Builder). The best way to feed these calcium supplements is to add 1 or 2 lbs. to the grain mixture, the higher amount being used when cereal hays are fed as well as when the cows are producing most heavily. Additional amounts can be fed by placing a box in the barnyard containing either the calcium supplement alone or mixed with an equal amount of salt.

Phosphorus is very seldom lacking when cows are being fed suitable rations containing good quality hays and grain. Phosphorus is most likely to be lacking in the hays grown on phosphorus deficient soils. While legume hays contain more phosphorus than other hays, they may not contain enough to provide the required amounts.

Grains, and especially wheat bran, are rich in phosphorus, and cows fed a few pounds or more daily of a good concentrate mixture will receive ample. Phosphorus deficiency will therefore only occur when the cattle are receiving almost their entire ration in the form of roughage. As this practice is not recommended there is little possibility of a phosphorus deficiency occurring. When there is likely to be a phosphorus deficiency, however, bonemeal or mono-calcium phosphate if fed as prescribed under the discussion of calcium will provide ample quantities of both minerals.

Commercial mineral mixtures usually contain large percentages of the minerals mentioned. The addition of other minerals less likely to be deficient lowers the percentage of those needed and makes the mineral more expensive.

Vitamins for Dairy Cattle

Recent research has shown that dairy cattle usually do not suffer from vitamin deficiencies when good rations are fed. Deficiencies of one or two of the vitamins may occur in stock that are not properly fed. Some of the vitamins are of special interest because they occur in milk and are important in human nutrition. A few of the mort important vitamins will be discussed in relation to normal nutrition or milk composition.

Vitamin A, although essential for growth, health and reproduction, is especially important in preventing infections of the mucous membranes of the respiratory and digestive systems. Carotene, a color pigment found in the green leaves of plants, is the original source of vitamin A in animals. Vitamin A is colorless. When cows are on green pasture, their milk is richer in color and higher in vitamin A than when fed on the usual winter rations of hay and grain.

Since carotene and vitamin A are destroyed by oxidation, freshly cut hay when exposed to the sun and rain loses part of its vitamin A potency. It is also true that hay stored in the mow may lose most of its vitamin A before spring. Dairy cows fed old, colorless hay for prolonged periods may develop symptoms of a vitamin A deficiency. The lack of this vitamin may result in diarrhoea and slow growth in calves and in the case of cows, lowered fertility and birth of weak calves. Inflammation of the eyelids, sore, watery eyes, sensitivity to light and blindness are other symptoms of a vitamin A deficiency.

Vitamin B, originally considered to be a single vitamin, is now known to consist of at least three separate vitamins, namely, thiamin, riboflavin and nicotinic acid. While these are known to be important for other classes of animals, they

are not important for dairy cattle. It may be mentioned, however, that nicotinic acid has been used to control scours in newborn calves.

Vitamin C (ascorbic acid) prevents scurvy in man. It is not important in the feeding of farm animals because it has been shown that they are able to build up ascorbic acid from other substances in their feed. Some recent experiments have proven that the injection of ascorbic acid has improved the activity and fertility of certain slow breeding and low fertility bulls, and has also increased the fertility of cows.

Vitamin D is known as the "sunshine" or anti-rachitic vitamin. It is this vitamin that enables animals to absorb calcium and phosphorus. The need for vitamin D is high during periods of growth, and it is therefore important in the feeding of calves to prevent the development of rickets. It is also important during pregnancy for the normal bone development in the unborn calf, and during lactation because milk contains relatively large amounts of calcium and phosphorus.

Growing plants contain little or no Vitamin D, but do contain a substance known as ergosterol, which is changed to vitamin D by exposure to sunlight or ultra violet light rays. Therefore only hays that have been exposed to sunshine can be regarded as good sources of vitamin D. Grains, roots and tubers contain no vitamin D. Dairy cattle usually receive their vitamin D from sun cured hay as well as by their exposure to sunshine. Summer sunshine is more effective than that of the winter months in changing certain sterols in the animal tissues to vitamin D.

Milk varies in its vitamin D content according to the amounts of vitamin D in the ration and in accordance with the extent of the animal's exposure to sunshine. Summer milk contains more vitamin D than winter milk. Considerable interest has been shown in the production of milk that is rich in vitamin D. Feeding cows cod liver oil or other fish oils rich in vitamin D has been tried, but has resulted in a decrease in fat production and other undesirable effects. The feeding of irradiated yeast to cows has resulted in a considerable increase in the vitamin D content of the milk. Irradiating milk with ultra violet light and by adding a vitamin rich concentrate directly to the milk is the usual method employed in producing milk rich in vitamin D. These practices are, however, only justified when a special demand develops or when special marketing arrangements can be made.

Vitamin E is the vitamin associated with reproduction. All natural feeds contain this vitamin, and it is especially rich in the germ of seeds. There is little possibility of sterility in

dairy cattle arising as a result of vitamin E deficiency when they are receiving a ration of reasonable variety and quality. While the feeding of wheat germ oil rich in vitamin E for improving the fertility of cows and bulls has met with some degree of success, the improvement may possibly have been derived from constituents other than vitamin E.

Certain other vitamins have been isolated, but it has not yet been shown that they are important in the feeding of dairy cattle.

Water Requirements

The amount of water required by cows is influenced by their size, milk production, kind and amount of feeds fed, as well as by the temperature of the air. The results of experiments conducted at the University of Alberta show that dairy cows consumed between 3½ to 4½ gallons of water for each gallon of milk produced. Amounts up to 20 gallons of water daily were consumed by the heaviest producing cows.

Cows will consume more water if allowed free access to it at all times than if allowed water only once or twice daily. Then too, they will consume more water when it is not too cold and when they are not exposed to extremely cold temperatures or unfavorable weather. In connection with the University of Alberta experiments already mentioned, when cows had access to water at all times they consumed almost 8% more water and produced about 6% more milk than cows watered twice daily. While a watering system in the barn is much better than outdoor watering, it is not essential to have individual water bowls for the cows if some other system can be devised to allow cows access to water more often than twice daily.

Cows will drink more water after eating grain and hay than at any other time. The feeding of ensilage or other succulent feed is beneficial mainly because they contain large amounts of water and not because they possess any special nutritive value. If water is not available in the barn, the outdoor water troughs should be sheltered from prevailing winds and a water heater used to raise the temperature of the water high enough to enable cows to consume a maximum quantity.

Summer Feeding

Pasture is the ideal feed.

Pasture is the natural feed of cattle. As has been mentioned already, it furnishes an ideal feed for the dairy cow at a lower price than any other feed. Pasture grasses supply nutrients of the right kind for growth, pregnancy and milk production. The immature grasses are more palatable, and they contain more protein, minerals and vitamins than the same plants when more mature.

Pasture provides the cheapest feed.

Pasture yields vary according to the type of soil and kind of plants grown, as well as upon moisture and temperature conditions during the growing season. The tonnage yield of pasture is greater and more nutritious than the hay crop, and an acre of pasture will produce more milk and butterfat than the same crop cut and fed as hay. In addition, the cow will do a much more economical job of harvesting than when the crop is cut and stored as hay.

Pasture alone is insufficient for high producing cows.

When cows are on good pasture, they can consume enough grass to maintain themselves and produce about ¾ lbs. of butterfat daily. This means that in the case of cows producing not more than 20 lbs. to 25 lbs. of milk, good pasture will take care of their requirements. Supplementary concentrate mixtures are necessary to meet the needs of cows producing more than these amounts. The cows will not only maintain production at higher levels during the pasture season, but will maintain that higher level after the pasture season has ended.

Feeding concentrates to cows on pasture is a profitable practice when prices are normal in relation to the price received for milk or butterfat. When feed prices are relatively high or the prices of dairy products are relatively low, the profitability of grain feeding becomes less. The amounts of grain to feed cows on pasture is shown in Table IIIb, page 29.

The concentrate mixture fed to cows on pasture can be carbonaceous, consisting only of ground oats or barley, because the pasture grass consumed will provide the necessary protein as well as minerals.

Milk production during the fall can be maintained.

During the latter part of the summer and early fall the growth of pastures is retarded and fails to provide as much feed as during the late spring and early summer. As the pasture growth declines, it becomes difficult or impossible for the cows to obtain sufficient pasture for a good fill. Milk production will decrease under these conditions unless extra feed is provided to offset the pasture shortage. This extra feed can be provided either in the form of freshly cut hay crops, silage, increased grain allowance, or by providing additional pasture.

Providing ample pasture is profitable.

Because pastures provide the cheapest source of food, ample pasture should always be provided. On most dairy farms native pasture on land unsuited for cultivation is insufficient to meet the needs of the dairy herd, and cultivated pasture crops must be seeded. Crops suitable for pasture vary in

yield as well as the length of growing season. Less pasture land is required when the heavier yielding and longer growing pasture crops are grown.

Perennial grass pasture crops.

Most grass crops that make suitable pastures can also be cut for hay. Such grasses as timothy, brome, slender wheatgrass (western rye), creeping red fescue, red top, crested wheat, Kentucky blue and reed canary grass can be used alone or in mixed pastures under conditions most suitable for their growth.

The soil and rainfall conditions most favorable for their growth have already been discussed individually under the subject of hays. In general, grass crops provide less forage and for a shorter period than the legume or mixed legume-grass pastures.

Legume pastures.

These yield more forage, and can be pastured for a longer period than the annual or perennial grass pastures, but the danger from bloat is greater. These crops are usually cut for hay for one or more years before being used as pasture in most good rotational crop plans.

Alfalfa is both highly palatable and nutritive, but cattle pastured on this crop are more subject to bloat than on any other single pasture crop. The danger from bloat can be lessened in several ways: (1) by turning cows on to the alfalfa pasture after they have eaten a feed of hay, or (2) after they have just previously been foraging on a grass field, (3) by not turning cows on alfalfa pasture which is moist with dew, nor (4) on to pasture of recent seeding. It is best to pasture on an older crop that has been cut for hay for two or more years. (5) by growing an alfalfa-grass pasture mixture. Alfalfa can be pastured much more safely when it comprises only part of the pasture mixture. The grass content of these mixtures greatly reduces the danger of bloat.

Sweet clover pasture may not be as palatable as alfalfa until cows have become accustomed to it. It may cause bloat during the first year of growth, but rarely causes bloat the second year unless early in the spring when making the most vigorous growth. It is a difficult crop to pasture evenly, and portions of the field usually grow rank and coarse. On irrigated pastures this can be controlled by proper irrigation.

Red clover (altaswede) pasture is very suitable for a dairy pasture. There is not as much danger of bloat as in the case of alfalfa, but the same precautions against bloat should be

taken. Red clover is best used in a legume-grass pasture mixture.

Pasture mixtures are the best.

They furnish more forage than the single crop pastures and provide a longer pasture season. Mixed pastures should contain both legume and grass plants most suited to the soil condition as discussed previously under the individual hays. (See pages 30 to 32.) Some pasture mixtures make excellent hay crops, and the practice of utilizing the crop for hay for a year or more after seeding before using it for pasture has proven to be satisfactory for a rotational scheme. The heavier yields of these mixed pastures reduces the land required for pasture and allows more land to be used for other crops.

Suggested Pasture and Hay Mixtures

In the black soil areas where rainfall is fairly good, the following seeding mixture per acre is suggested:

Alfalfa	4
Altaswede Clover	3
Brome	2
Kentucky Blue Grass	2

In the gray soil areas with similarly good rainfall the above mixture could be altered by substituting white dutch or alsike clover for the altaswede clover.

For the drier districts of the province, crested wheat grass is the chief pasture crop and can be seeded alone at the rate of not more than 8 lbs. If experience has shown that other crops such as sweet clover, alfalfa or brome will make a reasonably good growth, small amounts can be substituted for part of the crested wheat.

In areas of intermediate rainfall the mixture should contain at least one legume, and a drought resistant grass that is adaptable to local soil conditions.

It is also suggested that the pasture mixture used be such as can be used as a hay crop for one or two years after seeding before being used as pasture.

Supplementary Pasture Crops

Before the main dairy pasture can be used in the spring and after it ceases to provide ample forage in the fall, cows must be either barn fed or placed upon a supplementary pasture. The seeding of special crops has proven the cheaper and most satisfactory method of feeding the herd during these periods.

Oat pasture can be seeded early or late to provide either the main pasture or late supplementary pasture. When used

as the main pasture it does not provide as early a pasture as do the perennial grasses. Oat pasture has a fair carrying capacity, but does not have a long growing season. For a supplementary pasture oats can be seeded at the rate of 2¾ bushels per acre late in July on well prepared land, and under suitable conditions will provide four to six weeks of pasture after the regular pasture has been finished.

Fall rye is the earliest spring crop, but only supplies pasture for a short period. In the spring it is only used until the other pastures are ready, and then plowed up and reseeded the same year to a late sown crop. However, it also can be used in the previous fall if precaution is taken not to overgraze.

Rape pasture is not desirable forage for the milking herd. It may, however, be used satisfactorily for young stock and dry cows. There is, however, some tendency to bloat when cattle are pastured on wet rape. It is quite laxative and therefore is usually not fed as the sole pasture. Milk from cows on rape pasture has a disagreeable flavor. For these reasons rape is not recommended as a suitable pasture.

Feed and Care of Cow at Calving Time

Calving time is a critical period in the life of a cow, and her feeding and care during this period has a great deal to do with her subsequent milk production. At parturition her

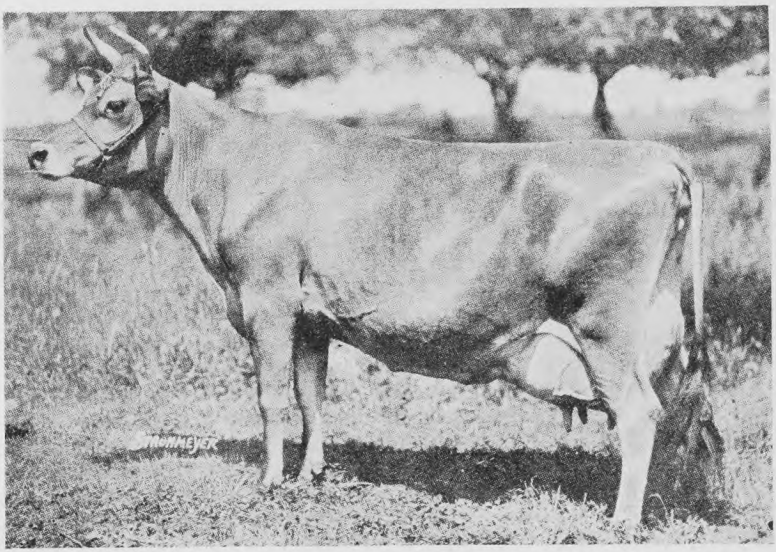


Fig. 7.—The world's highest producing Jersey, Brampton Basilua, imported and owned by B. H. Bull & Sons, Brampton, Ontario, with 5-year-old record of 19,012 pounds of milk and 1,313 pounds of butterfat.

whole system changes from that of pregnancy to lactation. Before a cow calves, the feed she eats is used to nourish the embryo and to build up her own tissues in preparation for the coming lactation period. No milk is being produced and her nutrient needs are therefore mostly carbonaceous and relatively small. But after calving she begins to secrete large quantities of milk which necessitates large quantities of protein and minerals. Failure to provide these nutrients results in a depletion of the cows' body reserves followed by a reduction in milk flow.

A great deal can be done to aid the cow in making this drastic change in function. She should receive invigorating feeds prior to calving to assist her during parturition. There should be a reduction in the amount of concentrate fed so as to avoid digestive disorders and to stop the tendency to put on flesh. She should be offered warm water often to meet her increased water requirement. For a day or two prior to calving it is good practice to feed warm bran mashes of 3 or 4 lbs. twice daily and to allow her to consume the usual amount of good quality hay.

Following calving, warm bran mashes should be continued for about two days to help stimulate milk production and aid in the expulsion of the afterbirth. If the udder continues to be inflamed and "caked", the bran mashes should be continued for a longer period. After the udder reaches nearly normal, the bran should be gradually replaced by small amounts of the herd concentrate mixture. Cows should not be fed a full grain allowance until three weeks or longer after calving if the udder continues to be inflamed.

Cows that are to calve should be placed in a clean box stall and be allowed to care for their calves as soon as they are dropped. Cleanliness at this time is important for the health of the calf, and as a means of protecting the herd in case there has been an abortion. In the latter case the dead calf and afterbirth should be carefully removed and burned, and the box stall again disinfected.

A mature cow in good condition will usually expel her calf without any assistance. However, some assistance may be necessary for young heifers and for cows that are weak, overly fat, or that fail to develop normally in their pelvic area. When the calf is being presented in an abnormal position it is often possible to manipulate it into normal position to facilitate expulsion.

The cow should not be completely milked out for two or three days as there may be some danger of milk fever developing in a high producing cow. Leaving the calf with the cow during the first few days helps to remove congestion in

the udder. The cow should be milked to prevent too much accumulation of milk in the udder, but not all of the milk should be removed until the udder is well on the way to becoming normal.

If the calf is taken from the cow soon after it is born, the cow has to be milked several times daily to obtain the colostrum milk so necessary for the well-being of the new born calf. If the udder is congested, it should be massaged, given heat applications or otherwise treated to remove the inflammation. Some dairymen believe that when the calf is taken from the cow soon after birth it is easier to train the cow for the normal milking procedure and to teach the calf to drink from a pail.

It is important to treat cows with kindness during parturition. Cows handled quietly and gently will allow the attendant to give any necessary assistance during parturition and can be quickly induced to let down their milk and be milked.

Fig. 8.—Calves of today are the milking cows of tomorrow.

Raising the Calf

In average herds approximately one-quarter of the cow herd has to be replaced annually. The heifers retained must be as good or better than the cows if the herd production is to be maintained or increased. If the herd sire has been well chosen, the calves born in the herd should be an improvement on their dams. While replacements can often be purchased at

low prices there is some speculation as to their milk producing ability, freedom from disease, or abnormal hereditary traits. Raising heifer calves out of the best cows in the herd and sired by a good purebred bull is the surest way to obtain satisfactory replacements.

Raising calves properly is as important as the feeding and care of the milking herd. The calves of today become the milking cows of tomorrow. Calves are born with an inherent milk producing possibility, which only becomes a reality when they are reared under conditions most favorable to the full development of all parts of the body. Stunting from inadequate feed, ill-health or improper care reduces the future milk producing possibilities of the heifer.

Calves should get the right start.

It is most important that calves get well started in life. The dairyman should make sure that the calf begins to breathe properly as soon as it is dropped by making certain that the fetal covering is not over the nostrils. The cow should be allowed to lick the calf dry. Tincture of iodine should be applied to the navel as soon as the calf is born to prevent infection. If the calf has not suckled within a few hours, assistance should be given to make sure the calf receives the colostrum milk. This milk is essential to stimulate the digestive tract. It acts as a laxative and contains vitamins and minerals necessary for growth and prevents calfhood infections and diseases. In case the mother dies, castor oil has been found to be a fair substitute for the colostrum milk. If the cow's milk is too rich in fat, it may result in scours. In such cases the calf should be taken from the cow and fed a limited amount of the same milk diluted with water.

The first three weeks.

The calf should always be fed its own mother's milk until three weeks of age. Extreme patience should be exercised in teaching a calf to drink milk from a pail. Quite often calves will drink too rapidly and develop digestive ailments. Nippled pails or other devices can be used to induce the calf to drink slowly. It is only necessary to feed a pound of milk daily for every ten pounds of live weight. Small Jersey calves require six or seven pounds, while a one hundred pound Holstein calf would require ten pounds of milk daily. Scours are sometimes caused by the calves drinking too much milk that is too rich. The milk allowance should not be increased above the amounts mentioned above, and at no time is it necessary to feed more than twelve pounds daily. It is essential that the milk pail be thoroughly washed after each feeding, as disease bacteria multiply very rapidly in dirty utensils.

Calves will begin to nibble at grain when they are ten to fourteen days old. Small handfuls of coarsely ground oats can then be thrown into the empty milk pail as soon as the milk has been drunk. After the calf has learned to eat grain, it can be self fed without danger of over-feeding for several months. Up to three weeks of age calves will eat very little hay, but it is a good practice to allow them to eat as much hay of good quality as they desire.

Three weeks to four months of age.

This should be the period of skimmilk feeding. If skimmilk is not available, whole milk feeding should be continued. The change from whole milk feeding to skimmilk feeding should be gradual and take approximately a week's time, as any sudden change in feeding will cause digestive ailments. The feeding is very important during this period because considerable amounts of protein and minerals are still required. However, there is no advantage in feeding large quantities of skimmilk, 12 lbs. being usually sufficient to supplement the hay and grain part of the ration.

A satisfactory concentrate for calves of this age can be ground oats alone or a mixture of equal parts oats and barley. It may be self fed until 3 lbs. of grain is being consumed daily without danger of over-feeding. Calves, however, will not require more than 3 lbs. of concentrates while receiving skimmilk. The feeding of good quality hay should be continued and calves should be allowed to eat as much as they desire. The consumption of hay should be encouraged to aid in the development of a good digestive system.

In the summer calves of this age cannot consume enough grass to equal hay and grain feeding. It is best to place the calves in a small grass paddock. Skimmilk and grain should always be fed while the calves are on pasture, and they should have access to some hay.

Water should also be provided, as the skimmilk fed does not satisfy the water requirement. This fact is sometimes forgotten when calves are young and kept in the barn.

Four months to one year of age.

During this period there is continued rapid growth and the nutrient requirement is fairly high. Skimmilk feeding may be discontinued at four months of age if good quality hay and a suitable concentrate mixture is fed. Protein and minerals should be added to the grain mixture to partially replace those that had been supplied in the skimmilk. If only grass hays are available the concentrate mixtures with 20% wheat bran or 10% linseed meal would be more suitable than grain alone.

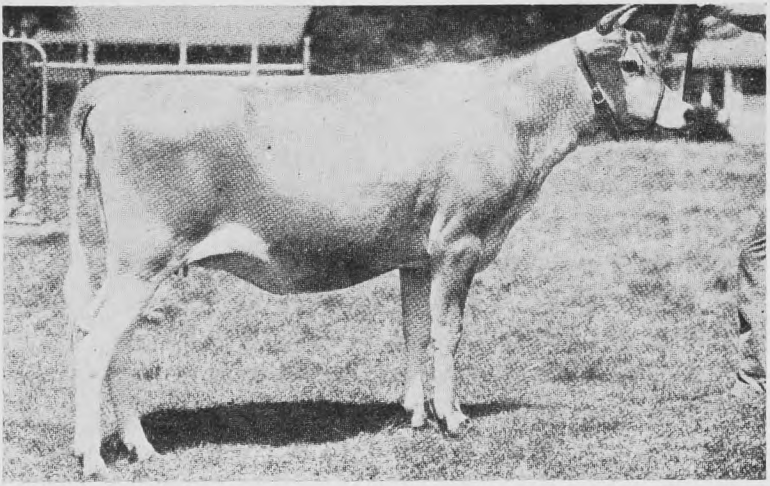


Fig. 9.—Only heifers well raised become profitable cows.

The concentrate mixture should also contain 2% of bonemeal. The amount of concentrate mixture to feed daily depends upon the condition of the calf. Between two to four pounds of concentrates are usually required to keep the calf in fair condition and growing vigorously. There is no advantage in feeding dairy calves so that they carry excess flesh. Heifers should fed so they develop the ability to consume large roughage allowances rather than the more expensive concentrate mixtures.

The hay fed should be of good quality to help replace some vitamins and minerals that had been supplied in the skimmilk, It is of particular importance that the hay be green as a deficiency of vitamin A may develop. Alfalfa hay is ideal for young heifers. It contains sufficient protein, minerals and vitamins to make it unnecessary to add protein rich supplements or minerals to the grain mixture.

Pasture grass is also ideal, but will not provide ample nutrients to meet all requirements. Grain feeding must be continued while the calves are on pasture, but the addition of protein rich supplements and minerals to the grain mixture is unnecessary.

Yearling heifers.

Year-old heifers are usually not difficult to feed as their protein and mineral requirement has become less. Usually these heifers can make normal growth on legume hay of good quality with a very limited amount of grain. The heavy feed-

ing of roughage with limited grain feeding helps to develop a good framework and large barrel, a necessity for high production. Since good quality hay or luxurious pastures may not always be available, the feeding of suitable grain and supplements is often necessary. The amounts of these feeds fed should be based upon their condition of flesh and general thrift.

Milk Substitutes and Calf Meals

On farms where whole milk is sold, it is impractical to provide skimmilk for calf feeding and it is expensive to continue liberal whole milk feeding till four or six months of age. Some saving can be made by slightly reducing the whole milk allowance below the amount previously mentioned, or by feeding skimmilk substitutes, calf meals or gruels. The feeding of inadequate quantities of milk during the first few weeks or eliminating milk before the calf is able to consume and digest substitute feeds results in the permanent stunting of calves and unthriftiness. Fresh whole or skimmilk contains nutrients that are ideal for young calves, and as yet a perfect substitute has not been discovered.

There are several ways of successfully raising calves on farms where whole milk is sold. First, by feeding minimum amounts of whole milk properly supplemented with a suitable concentrate mixture and hay. Second, by feeding a so-called "milk substitute", calf meal or gruel.

Numerous experiments have been conducted to determine how early calves can be weaned and how much the daily allowance of skimmilk can be reduced without affecting the growth and thrift of the calves. The answer to these questions was found to be largely dependent upon the suitability of the concentrate mixture and hay fed. In experiments conducted at the University of Alberta it was found that calves could be weaned at four months of age when receiving the following concentrate mixture with a good quality grass hay and not more than 12 pounds of skimmilk daily:

Oats	38 lbs.
Barley	30 lbs.
Wheat Bran	30 lbs.
Salt	2 lbs.

From the results of other experiments it was concluded that the more complete a concentrate mixture is in the nutrients required by the calves, the less milk will be required and the sooner calves can be weaned. The following concentrate mix-

ture proved slightly more satisfactory in feeding calves on limited amounts of milk than the ration previously mentioned:

35 lbs. oats
28 lbs. barley
12 lbs. wheat bran
10 lbs. red dog flour
6 lbs. linseed meal
5 lbs. blood flour
2 lbs. bone flour
2 lbs. salt

100 lbs.

Commercial calf meals and gruels contain varying amounts of skimmilk or sweet cream buttermilk powder and therefore are a better substitute for milk in calf feeding than the two mixtures previously mentioned. The price of skimmilk or buttermilk powder is usually either too expensive or unavailable in the ordinary market channels for dairymen to mix their own calf meals. In the event that these powders become available the following mixtures are suggested:

30 lbs. oats
30 lbs. barley
20 lbs. skimmilk powder
8 lbs. wheat bran
8 lbs. linseed meal
2 lbs. bone flour
2 lbs. salt

100 lbs.

30 lbs. oats
20 lbs. skimmilk powder
20 lbs. wheat middlings
15 lbs. hulled oats
7 lbs. blood flour
5 lbs. linseed meal
1 lbs. salt
2 lbs. bone flour

100 lbs.

A good calf meal should contain about 25% crude protein, 3½% fat and not more than 4% fibre.

The meal is usually mixed with six or eight parts of water and fed in the same quantities as would skimmed or whole milk. The calf meal or gruel does not replace the hay and grain usually fed to skimmilk calves. The following table summarizes the suggestions presented in feeding calves:

	Whole or Skimmed milk	Calf Meal Gruel	Hay and Grain
1- 3 days	With dam		
3- 21 days	8-12 lbs.		
21- 28 days	9 lbs.	3 lbs.	Same as
28- 35 days	7 lbs.	5 lbs.	for
35- 50 days	5 lbs.	7 lbs.	skimmilk
50-120 days		12 lbs.	calves

Comparing the different ways of feeding calves, those fed the prescribed amounts of skimmilk will make normal growth while calves fed limited amounts of whole milk or calf meals usually do not grow as rapidly or maintain the thrift of skimmilk fed calves. In other words, a perfect skimmilk substitute has as yet not been found.

Exercise is essential for calves of all ages.

During the winter calves should be allowed the freedom of a small pen in a part of the barn that is well lighted. When the weather is not too severe they should be outdoors in a pen or yard protected from prevailing winds. The outdoor sunshine prevents the development of rickets and aids normal bone growth and development. In the summer the calves should be kept in a grass paddock with some shelter from the hot sun and inclement weather.

Dehorning

Horns on dairy cattle make their handling more difficult, and are a source of danger to other cattle and to the dairyman.

The use of caustic potash to remove horns of calves when one or two weeks of age is a more satisfactory method than removing horns of older cattle by sawing or clipping. The caustic potash method is also more easily accomplished and causes the least discomfort to the animal.

Procedure: remove the hair surrounding the horn button with shears or clippers. Rub a moist stick of caustic potash over and around the horn button until the skin ruptures and begins to bleed slightly. When excessive amounts of potash are used, some may run down the face and endanger the eyes. To prevent the spread of potash, a ring of vaseline can be applied to the area immediately surrounding the horn button, and the calf isolated from the others and protected from rains.

For dehorning older cattle, dehorning clippers or saws are used. The use of clippers is best for younger animals whose horns are not too heavy or brittle. The horns should be removed as close to the skull as possible to prevent further growth. After bleeding has ceased, disinfectants should be applied that will prevent infection and repel flies. Pine tar is recommended as it will stick to the wound for several days and is a good fly repellant.

Feed and Care of the Dairy Bull

The feeding of the dairy bull is relatively simple, but some thought should be given to the kinds and amounts of feed required to maintain his breeding efficiency. He should be fed as much hay as he will eat without undue waste. The amount of grain to be fed will depend upon his condition of flesh and amount of service. It is desirable to maintain a bull in a thrifty condition by feeding suitable feeds in sufficient quantities. At no time should bulls be allowed to become excessively fat or thin.

The care and management of the dairy bull is of extreme importance because improper care and management may lead

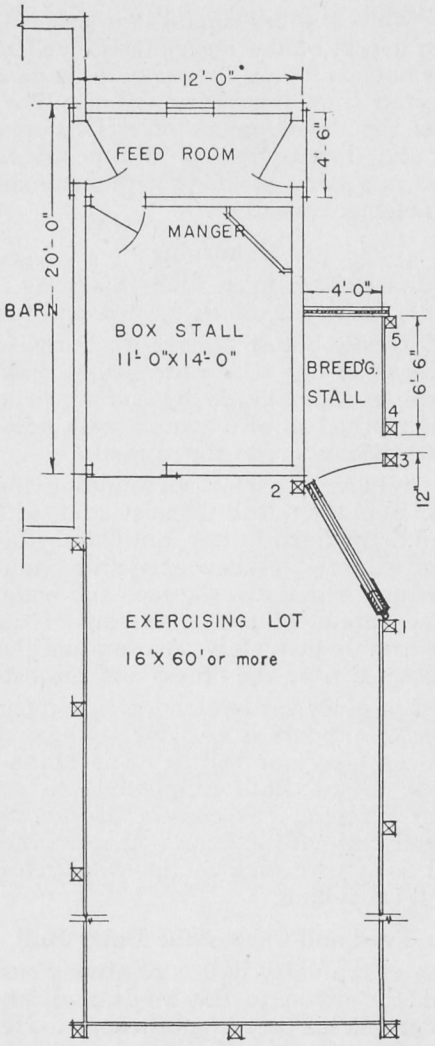


Fig. 10.—Floor plan of a bull shed, exercising yard, and breeding stall.

The floor plan shows the desired location of the posts numbered in the order in which they should be situated. The stall is 6′6″ long from post 4 to post 5 and 4′ wide. Post 4 is situated 12″ from post 3 so the attendant may facilitate service if necessary. The width of the gate from post 1 to post 2 may vary from 6′ to 8′. The stanchion at the end of the stall is built in a swinging gate which opens to the outside so the cow may be let out.

Courtesy Illinois Agr. Exp. Sta.

to viciousness and impotency. The management of a herd bull is usually not difficult if he is properly handled when young. A ring should be put through the nose before he is a year old and be changed for stronger ones as he gets older. A strong bull staff should always be used in leading a bull. An additional safety device is a six or seven foot chain with one end looped around the horns and the other end passing through the nose ring, the end being allowed to drag.

Keep the bull in separate quarters.

The bull should not be allowed to run with the herd, as bulls managed in this way tend to become vicious. The bull should be housed in a separate shed or given a suitable box stall. Outside the shed or box stall there should be an exercising pen and yard where cows can be bred. This arrangement avoids the risk of injury to the attendant. A small grass paddock just outside the exercising pen is excellent for providing succulent forage during the pasture season. The fences holding the bull should be strongly built. The additional use of a single electric fence wire strung inside the bull exercising pen and paddock prolongs the life of the fence and aids in keeping the bull under control.

Exercising the bull is important.

Bulls require plenty of exercise if they are to be kept in a vigorous condition. Various methods have been devised to induce bulls to exercise. An empty barrel or keg on the ground in the bull pen, or a heavy block of wood hung between two posts provides something for the bull to exercise on. When an exercising pen is not available, bulls can be tied to a ring which slides on a cable. Usually these cables are about 100 ft. long and strongly constructed. The lead chain should be attached to the bull ring and be of a length which does not allow the bull to step over.

Service.

The young bull can be used for light service when ten to twelve months of age. Mature bulls can serve three or four cows weekly. Usually one bull if kept in good condition can be used on 80 to 100 cows annually if they are bred to freshen uniformly throughout the year. Overworked bulls become inefficient breeders, as the number and vitality of the sperm cells become greatly reduced. Only one service should be given to each cow when the bull is being used regularly. If, however, the bull has been idle for ten days or longer, cows should be given two services because the semen in the first service may contain a high proportion of dead sperm cells.

"Safety First" should be practiced by dairymen in all dealings with dairy bulls. Regardless of how quiet and harmless a bull may appear, experience has proven that no bull can be trusted at all times. In feeding and handling any bull the dairyman should always be on the alert and take no unnecessary chances.

Cost of Producing Milk

The main purpose of determining the cost of milk on any farm is to find out how efficiently milk is being produced. This is done by comparing the individual cost items of one farm with those of another. By such comparisons the most efficient practices can be determined and applied on the farms showing the higher costs. Milk costs are usually calculated on a yearly basis. In calculating the cost of producing milk, the following charges are made:

1. Feed costs.
2. Labor costs.
3. Building and equipment cost.
4. Depreciation and interest on herd values.
5. Miscellaneous charges.

Feed cost comprises from 40% to 60% of the total cost of producing milk. It will vary from year to year according to fluctuations in feed prices. The fact that feed accounts for such a large proportion of the cost makes possible wide variations in costs between farms using different feeding practices. Feed costs are low (1) when the less expensive feeds are fed, (2) when the cows are not overfed, (3) when cows are not underfed to seriously affect milk production, and (4) when balanced rations are fed.

Labor costs also vary greatly and range between 25% and 40% of the total cost. Differences in wages, in the estimated value of family help, and what the owner considers his work is worth determine most of the differences in labor costs between farms. The cost of hauling milk from farm to market is sometimes included under this item. Differences in the efficient use of labor as shown by differences in hours of labor required to produce 100 lbs. of milk may be caused by differences in equipment used and in the arrangement of the barn.

Building and equipment costs amounts from 5% to 15% of total costs, and largely depend upon the value of the dairy barn and milk shed as well as equipment. The farmer should charge a reasonable interest on his dairy barn and equipment investment and also should charge depreciation on same. Those dairymen who build unduly expensive barns and buy expensive equipment will have much higher costs for this item than dairymen using less expensive barns and equipment.

Cow charge includes the interest on the investment plus depreciation. This charge usually is only 6% to 8% of the total cost. Cows only average from four to five years' production in a dairy herd, which makes the depreciation charge rather high. This may appear to be a short time, but when it is realized that disease, injuries, sterility and other ailments take a heavy toll, this charge is not too high.

Bull charge.—This is only 3% to 6% of the total cost. It varies likewise according to the value of the animal, and whether or not the bull will have a higher or lower value when sold. The bull charge for each 100 lbs. of milk is necessarily high in small herds because the item will be the same in a ten cow herd as in a 50 cow herd.

Miscellaneous charge may amount to 20% or 30% depending upon the number of items included, and upon the expense of each. These items include cow testing fees, medical and veterinary fees, dairy magazines, disinfectants, breed association fees, etc.

Production per cow is the greatest factor.

Production can greatly affect the cost of producing milk because the cost items increase at a slower rate than milk production. Thus, as production increases, the cost of producing 100 lbs. of milk or a pound of butterfat decreases. Dairymen with high producing herds have a lower cost of production than dairymen with low average herds. All dairymen should strive to reduce the costs of producing 100 lbs. of milk or 1 lb. of fat by increasing the average production of their herds.

Increasing production per cow can be attained by (1) using better bulls, (2) culling out low producers, (3) feeding more suitable rations, (4) providing adequate all-season pastures, (5) controlling diseases, and (6) breeding for more early winter freshenings.

Increases in production resulting from improved methods of management are accomplished with little or no increase in cost, thus producing a greater net income.

Increasing labor efficiency.

The labor required to produce each 100 lbs. of milk is reduced as the size of the herd increases. This is especially true when small herds are increased to 10 to 12 head, a size considered most suitable for a one-man dairy farm. Providing pastures nearer to the barn, improving barn procedure in feeding and milking, and installing labor saving devices or equipment are other methods of reducing labor costs.

Fig. 11.—A profitable cow, University Rosebud Pontiac 124830, bred and owned by the University of Alberta. A 20 year old cow that produced 14 calves and has official records totalling over 180,000 pounds of milk, 7,000 pounds of butterfat.

Combining Other Farm Enterprises with Dairying

Dairymen should be interested in making the greatest total profit from all of the enterprises on the farm rather than from dairying alone. As a general rule on every farm there are certain combinations which will yield greater total net profits than any one enterprise alone. The combination of enterprises established on the farm is likely to be influenced by the aptitudes of the farmer and also by crop yields and certain economic conditions. In creamery areas the net earnings usually can be increased by keeping hogs or poultry since these make the most efficient use of the skimmilk available. In areas where whole milk is sold, cash crops may prove the most profitable combination along with dairying.

Dairying is one of the most intensive of farm enterprises and involves many different kinds of work, each of which has to be efficiently done to make it profitable.

Milk Secretion and Milking Practices

A knowledge of how milk is secreted is of practical value because it suggests how milking can be most efficiently done. During recent years certain discoveries have been made that explain how and why certain things happen in the udder of milking cows. There is, however, still a great deal more to be learned about this complex process. From the knowledge already available, certain principles for milking cows have

been established. By applying these principles the dairyman can get the most milk at each milking as well as throughout the lactation period.

The normal cow's udder consists of four mammary glands called "quarters". The amount of milk that is secreted depends upon the size and amount of glandular tissue in the udder. The udder contains innumerable connected ducts or openings of different sizes that hold the milk which has been secreted. The smallest of the openings are microscopic in size and are called aveoli. Each small opening is lined with special cells that take certain ingredients from the blood and reconstruct them into milk, which is then expelled into the microscopic openings.

Milk is secreted at all times.

While it was formerly believed that cows secreted milk only during milking time, it is now known that milk is secreted during the entire period between milkings. As proof of this, cows have been slaughtered just prior to milking time, their udders have been removed and milked or analyzed for the milk contents. These studies have shown that all milk that would have been expected by milking was present in the udder. Milk secretion is most rapid just after milking, and slows down as the glands fill with milk. This accumulation of milk in the udder builds up a pressure which may even rise sufficiently to cause milk secretion to stop.

Milk completely and often to get the most milk.

These facts concerning the rate of milk secretion have a very important bearing on how cows should be milked. First, the cows should be completely milked out because any milk remaining in the udder would leave a pressure that would reduce the rate of milk secretion that follows. The same thing occurse when cows fail to "let down" their milk, because not all the milk in the udder can be obtained. Secondly, if cows are milked more frequently, more milk will be produced daily, because the pressure will not rise to the same levels and retard milk secretion to the same extent. Some experiments have shown more than 20% increase in milk production for three times a day milking as compared with twice a day milking, and more than 30% increase for four times a day milking can be obtained. The economy of milking more than twice daily is largely dependent upon the amount of milk the cows produce. Thirdly, the best way to dry off cows is to leave considerable milk in the udder to retard further milk secretion. Some authorities even advocate abruptly ceasing to milk cows in order to dry them most quickly. Fourthly, the effect of udder

pressure explains why the inflation of the udder with air is effective in curing milk fever.

How cows "let down" their milk.

The milk in the aveoli and the smaller duct remains in the udder until it is squeezed out. The muscular contractions that occur at the time of milking explain how cows "let down" their milk. If these muscular contractions do not occur, not all the milk can be withdrawn, and it is said that the cows "hold up" their milk. Scientists have proven that a hormone secreted by the pituitary gland causes these muscular contractions that force the milk to be released in the udder. When milking first begins, the manipulation of the teat and the warmth of the hands causes the pituitary gland to secrete the hormone (oxytocin) into blood, which, when it reaches the udder, causes the muscular contractions to occur. This results in a rapid rise in udder pressure which remains higher than normal for several minutes. If cows are milked during this higher pressure period, all the milk can be obtained.

Other things may cause cows to let down their milk. The regularity of sounds or events that occur just prior to milking may become associated with the milking act and cause the secretion of the hormone responsible for the letdown. In addition, driving cows from pasture, bringing them into the barn, grain feeding, washing udders, the rattle of pails or the noise of the milking machine may all cause individual cows to let down their milk before milking is started. Such cows should be milked first to take advantage of the increased pressure present.

Rapid milking is recommended.

To get the most milk from cows, milking must be completed during the "letdown" period. Since this period lasts only a few minutes rapid milking is now recommended as the most efficient method. Milking machine companies have improved their machines to enable faster and more efficient milking. When cows are milked slowly most of the milk left in the udder after the extra pressure of the "letdown mechanism" is released cannot be obtained.

Cows can "hold up" their milk.

Cows that are frightened, or distracted from the usual events of milking or barn procedure, may not let down their milk. Allowing a dog to chase the cows, mistreatment, having a different person milk the cows, the presence of strangers in the barn or unusual noises during milking time are a few of the things that may cause sufficient disturbance to prevent the normal stimulation by the hormone secretion. Such cows will

hold up part of their milk, and this in turn acts to retard subsequent milk secretion. Regularity, quietness, kindness in handling the cows are factors which indirectly affect milk production.

Milking machines are not harmful when properly handled.

The latest models of milking machines if properly operated will maintain production at as high levels as the hand milking method, and will have no harmful effect on the cow's udder. The proper operation of a milking machine includes maintenance of mechanical efficiency, the observance of sanitary standards, as well as avoiding harmful practices in the use of the machine on the cows. The cows should be encouraged to let down their milk as soon as the teat cups are applied to the teats and removed as soon as milk flow ceases. If machines are allowed to operate when milk has ceased flowing, the result may be injury to the lining of the teat. For best results all milking machines should be operated according to the directions of the manufacturer.

Inheritance is involved in milk secretion.

Inheritance of milk production is made possible not only through transmitting udder size and quality to the next generation, but also by transmitting the ability to produce the essential hormones involved in the secretion of milk. Several hormones are necessary for the growth and complete development of the udder, the thyroid, pituitary and ovary each secreting one or more hormones whose activity enable udder growth and development to take place. Hormones which can stimulate milk secretion during lactation and others that act to inhibit milk secretion during pregnancy are also secreted.

The secretion of milk is therefore a series of complex processes, each requiring special conditions for successful completion. Feeding, breeding, care and management are important factors which are directly or indirectly associated with milk secretion in determining in a large measure, the extent to which milk production will approach the inherited capacity of the cow.

Cow Testing

When records are kept of the pounds of milk and butterfat produced by each cow, they furnish much valuable information. The keeping of these records enable a dairyman to determine which of his animals are proving the most profitable. Cows of low production due to short lactation periods or low test can be located and culled from the herd. By the use of records, calves from the best producing cows can be retained.

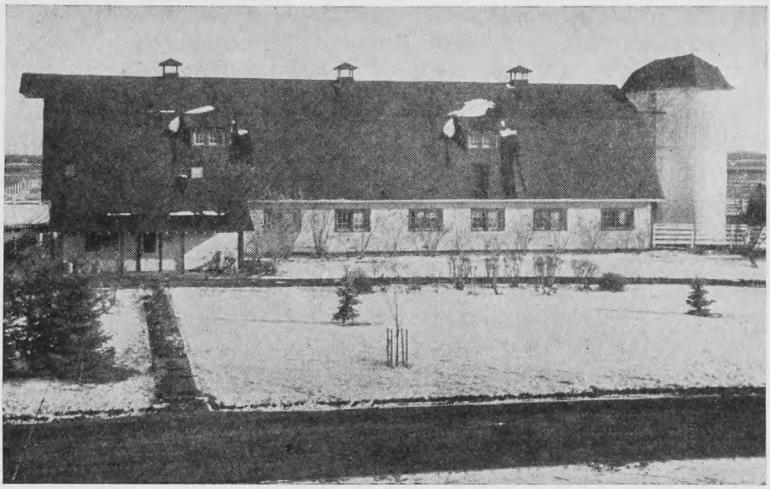


Fig. 12.—Dairy barn, University of Alberta, Edmonton, Alta.

The influence of feed changes can be noted and rations most efficiently utilized by herds can be formulated. The onset or severity of a disease or ailment can be often observed by a sudden drop in production, and remedies can be given before severe damage is done. When no records are kept none of these advantages are obtained, nor an increase in the profitableness of dairying secured with the same degree of certainty as when records are available.

It is more necessary for breeders of purebred dairy cattle to keep production records because the sale price of their bull calves and surplus females is largely dependent upon the production record of their animals. Purebred breeders must maintain the superiority of their purebred animals over grade stock by careful selection and the keeping of production records if fair prices are to be secured for their purebred sale stock.

The Dominion Department of Agriculture supervises the testing of purebred cows through the various breed associations. The breeder agrees to weigh the milk produced by all untested purebred cows and to send in monthly production reports. Inspectors are sent periodically to these farms to test the milk for fat. The certificates issued under this system are recognized as the official records of production for all purposes.

The Provincial Department of Agriculture supervises the testing of both purebred and grade herds for the individual breeders of the province. The dairyman agrees to weigh the milk every day and make monthly production reports. The

dairyman, however, takes samples of milk from his individual cows for shipment to the Dairy Branch or delivery to local testing centers at creamery or cheese factory points.

Three forms of certificates (blue, red and gold seal) are issued for cows meeting certain production requirements. While the cost of the Dominion scheme is $5.00 annually for each herd, the cost of the Provincial scheme is $1.00 for every ten cows in the herd.

Cow testing puts dairying on a business basis and demonstrates to the dairymen how the dairying enterprise can be made more profitable.

Dairy Barn and Equipment

Success in dairying cannot be attained without the use of suitable buildings. It is essential that cows be given comfortable and healthy shelter during the winter time, and that facilities be such that milk fit for human consumption can be produced. This does not mean that expensive buildings must be constructed since the essential features can be provided at reasonable cost.

Undue exposure of the cattle to inclement weather during both summer and winter has resulted in heavy losses to dairymen mainly through the lowering of milk production. Dairy cows which receive suitable shelter, feed and care will remain in better health and produce more milk at less cost than cows kept under poor conditions.

There are certain features that are essential in the construction of a suitable dairy barn. It should (1) be well lighted, (2) be well ventilated, (3) have facilities for maintaining sanitation and (4) have ample space for storing feed. There are other features that are desirable, such as (5) suitable planning, (6) warmth, (7) permanence, (8) reasonable cost, and (9) attractive appearance.

Sunlight is very important.

Good lighting is important for sanitation and health and provides more pleasant conditions for both man and beast. Sunlight kills germs, promotes warmth and ventilation and aids in keeping the barn dry and sanitary. A barn that is dark and damp cannot be kept sanitary. It is not a healthy place for cows to live or man to work. The production of clean milk in such barns is an impossibility. In constructing a barn, most of the windows should be on the sides getting the most sunshine and so placed that all parts are well lighted. At least five square feet of glass area should be provided for every one hundred square feet of floor space.

Fresh air is as necessary as feed.

Lack of fresh air can seriously affect the health and production of dairy cows. Cows exhale air that contains three times the moisture, one hundred times the carbon dioxide and only three quarters of the oxygen of fresh air. The air cows inhale can also be contaminated with barn odors. Unless good ventilation is provided, barn air soon becomes polluted and unfit for cows to breathe. A suitable ventilating system keeps the air in circulation and fresh.

The most satisfactory system for an average size barn is one in which there is one air outlet and numerous inlets. The inlets allow air to enter on the sides near the ceiling and to be removed from the center near the floor level. The amount of fresh air taken in to the barn can be controlled by a damper in the outlet flue without changing the openings of the inlet flues except in the presence of strong winds. Under average conditions an outlet flue two feet square in size would create proper air circulation for sixteen head of mature stock. This is at the rate of one square foot for four head.

Sanitation aided by proper barn construction.

Sanitation is obtained not only by providing light and fresh air, but by keeping the barn and cows clean. The barn should be arranged to facilitate easy removal of manure. Cement floors and walls without ledges, sharp corners or crevices, help to promote sanitation because there is less chance for filth to collect and disease bacteria to grow. Sloping floors and gutters with a drainage system to carry away all liquids help greatly to keep the barn dry and sanitary.

Feed storage should be ample.

Dairy cows in milk consume more feed than any other class of farm animals. Barn lofts in which large quantities of hay can be stored save considerable labor. When the herd is large there is an advantage in having the loft equipped with grain bins, storage space for commercial supplements and with facilities for the preparing of concentrate mixtures. Hay and grain chutes should be arranged so as to make roughage and grain feeding easy.

A well arranged barn reduces labor.

The arrangement of the barn should be planned to enable labor to be used most efficiently. Any convenience which simplifies feeding and cleaning reduces labor requirements. In barns with two lines of stanchions, cows can face outward or face the centre. When facing outward the removal of the manure and milking procedure is made easier, while on the

other hand when facing the centre, feeding can be done more quickly.

Warmth in a barn is desirable, but not essential.

Cows do best in a cool barn, temperatures of forty to forty-five degrees Fahrenheit being more desirable than higher temperatures. Barns kept at below freezing temperatures have not proven detrimental to cows if provision is made for ample bedding and freedom from cold drafts. The discovery of this fact has led to an increase in the popularity of a new type of barn in which the cows are kept loose in a pen and taken out only at milking time to a milking room of two to four stalls. In such barns the cows are fed their roughage allowance in hay bunks when loose in the pen and the grain only in the milking room.

Excessive heat in the summer is detrimental to cows, and suitable shelters should be provided in the field or barn.

Permanent, well-built barns recommended.

If dairying is to be a permanent farm enterprise, it is desirable to construct a barn with essential features for light, ventilation and sanitation. Makeshift, temporary barns usually do not have these features. The use of concrete, stone or brick for the floors and walls, together with steel fittings lengthens the life of the building, and provides a more suitable place for cows to live and for clean milk to be produced.

High cost barns not necessary.

Barns that are well constructed, and having all of the essential and desirable features need not be expensive. Such barns may cost more to build, but they usually will last long enough to make the annual cost reasonable. Carefully selected material and equipment made by reputable manufacturers should be purchased.

Build a good looking barn.

An attractive dairy barn and yards add to the value of a farmstead and to the reputation of the farm and herd. A well proportioned barn of good appearance which is painted to harmonize with the other buildings need not cost any more than a poorly planned, ugly building.

TABLE IV.

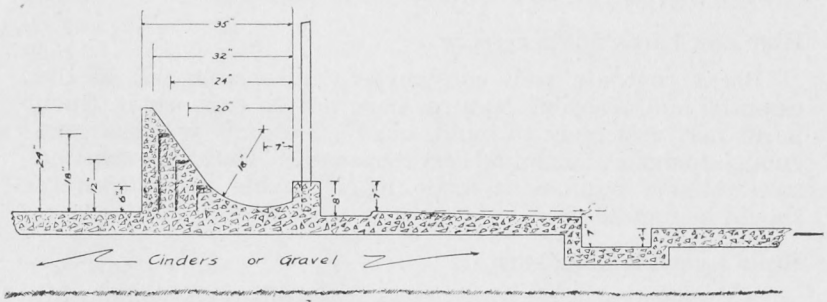
General Space Requirements

Cow Stalls

	Width	Length
Large Cows	3′6″ to 3′10″	5′2″ to 5′6″
Medium Cows	3′3″ to 3′ 6″	4′8″ to 5′2″
Small Cows	3′0″ to 3′ 3″	4′4″ to 4′8″

Note.—Gutters can be constructed at a slight angle to accommodate animals of various sizes, the longest stalls being located at one end of the gutter and the shortest stalls all at the other end.

Cow Box Stalls Partitions approx. 4′6″ high.	9′0″×10′0″ to 11′0″×12′0″
Bull Pens Partitions approx. 5′4″ high.	10′0″×12′0″ to 12′0″×14′0″
Calf Pens Partitions approx. 3′9″ high.	20 square feet for each calf
Ceiling height	7′6″ to 8′6″
Feed alley, cows facing in	4′6″ to 6′6″
Feed alley, cows facing out	4′0″ to 5′0″
Litter alley, cows facing out	8′0″ to 9′0″
Gutters (sloping to drains)	16″ wide, 4″ deep
Window space	5 sq. ft. glass to 100 sq. ft. floor space
Ventilator outlet	1 sq. ft. to 4 head mature animals



TYPICAL DAIRY STALL

Fig. 13.

DISEASES OF DAIRY CATTLE

BY

P. R. TALBOT

Professor of Veterinary Science, and Provincial Veterinarian

No attempt has been made to elaborate on the treatment of the diseases referred to in this Bulletin; in fact, when necessary to prescribe medicines we have endeavored to suggest the common ones, and those that are easily obtainable. In referring to important facts an effort has been made to avoid the use of technical terms insofar as it is possible in a Bulletin of this kind. We have also endeavored to select, from the material available, information which, in our opinion, would be of the most value to the small dairy farmer, and especially those who may be unable to secure the services of a qualified Veterinarian.

We have always been under the impression that a successful cattle owner should be able to treat minor ailments and to administer first aid in case of emergency, but it is inadvisable to administer drugs, the action of which he is not familiar with, or attempt to perform surgical operations. This is the work for the trained Veterinarian, for should improper treatment be given, the health, and even the life, of the animal may be jeopardized. Where possible the services of the Veterinarian should be utilized (if one is available), for serious losses have often resulted through the cattle owner making an improper diagnosis. This is especially significant in the case of infectious diseases. Infection in a herd, or spreading to other herds in a community, is of common occurrence and frequently assumes serious proportions before the outbreak can be checked.

A Veterinarian, if called on the first appearance of the disease, should it be infectious, could confine it to one farm, and often to one animal, and serious losses could thereby be prevented. Many of the diseases in dairy cattle especially could be prevented by proper management. Many of the small dairy farmers fail to follow the principles of sanitation required in connection with their farm buildings. Modern science has also shown that a great deal can be done to protect the health of our animals along preventive lines, particularly by proper feeding, housing and care. It is generally agreed that the most common way in which infection can be introduced into a herd is through the bringing on to a farm an animal affected with some disease. For this reason any new animal brought in contact with a clean herd should be ob-

tained from farms where the cattle are known to be healthy and have proved negative to the various tests that can be employed to detect such diseases. The isolation of newly purchased animals, until the owner is satisfied that the possibility of contagion no longer exists, is also a policy that can be followed to very great advantage. The danger of carrying infectious diseases to clean farms by means of visitors, farm utensils, or other means should not be overlooked.

The combatting of animal diseases has always been a difficult problem. New methods of detecting disease and the discovery of better and safer preventives are continually being advocated. What may be the accepted treatment for a specific disease today is often replaced in a remarkably short space of time by newer and more scientific means. The fact must never be forgotten that successful treatment for any disturbance of health is primarily dependent upon a correct diagnosis. The following are a few diseases commonly met with in dairy cattle.

Bang's Disease

Bang's disease, or often called Contagious Abortion, is probably the most serious affection occurring in dairy cattle. It not only has a serious effect in reducing milk production, causes the premature birth of the calf, but in addition often sets up an inflammatory condition of the female reproductive organs so that sterility results. The cause of Bang's disease is the Bacillus Abortus, and the organism may be found, not only in the udder, but in the generative tract of cows affected with the disease. The Bacillus may also be found in the intestines, as well as other organs of newly born calves. It has been found that infection frequently occurs through the discharges following abortion and that contaminated feed and water are common carriers of infection. The disease can be transmitted from one animal to another by direct contact. It is also often introduced into a herd by the addition of an infected cow. Cows of all ages may be susceptible, but heifers or young cows carrying their first or second calf appear to have a predisposition to infection.

Symptoms.

As a rule the disease develops slowly and may extend through several months of the gestation period, finally resulting in the elimination of the immature fetus. The early symptoms of impending abortion may pass unnoticed, but in some instances it is indicated by a swelling of the mammary glands and other signs of parturition. Abortion occurs most frequently from the second to the seventh month. Calves are sometimes carried almost to the full nine months, and although born alive are often so weak that they die within a few hours.

Complications often follow abortion; the most common being retained afterbirth. Should this happen, Septic Infection or Blood Poisoning may occur and the animal die. Should the infection be localized to the reproductive organs, the walls of the uterus may become thickened or the ovaries undergo certain changes and sterility results. Suppuration of the generative organs is a common sequel to Contagious Abortion, and it may persist for a long time. This will interfere with the breeding ability of the animal and also be a source of infection for other animals in the herd. For this reason a cow suffering with such discharges should be isolated from other cattle, and unless she responds to treatment should be discarded as soon as possible.

Considerable attention is being paid to the diagnosis of Bang's disease by means of the Agglutination Test. The blood of the animal to be tested is obtained by means of a sterile needle inserted into the jugular vein and collected into a sterile tube. The sample is then tested by a technician, who will be able to show if Bacillus Abortus is present or not. If the test is properly made it is a most reliable one.

Treatment.

Should a cow abort, the soiled bedding, fetus and membranes should be carefully disposed of, and the stall and floor thoroughly disinfected. The cow should not be allowed to come in contact with other cows until all discharges have ceased.

No drugs or medicinal remedies have been found effective in preventing or curing Bang's disease. Many so-called cures have been widely advertised, but after being thoroughly tested they have been found of no value. Various ways and means of controlling Bang's disease have been advocated, such as the "Test and Slaughter Method", "Test and Segregation Method" and even an "Area Plant" has been tried, but it is doubtful if any one method is adaptable for all conditions. The two first mentioned will eliminate Contagious Abortion from a herd if properly carried out, but they are expensive and require most careful planning on the part of the herd owner. In addition, there is always the possibility of reinfection taking place in the herd, and fresh outbreaks occurring.

For a number of years experiments have been carried out in connection with vaccines as a means of preventing Bang's diseases, and "Strain 19" is showing considerable promise of immunizing cattle against infection. So far, in Canada, vaccination is confined to calves between the ages of 4 to 8 months of age, and there is every reason to believe that immunity will exist for a number of years. We are of the opinion that

under proper supervision calfhood vaccination offers a solution for the control of Bang's disease, and it is believed it will eventually lead to the eradication of the disease from our herds.

Dominion Government regulations control the importation of "Strain 19" into Canada, and the vaccine is administered by Veterinarians only.

Retained Afterbirth

Of all the domestic animals the cow appears to be especially susceptible to this condition. The explanation for this is probably due to the fact that the attachments of the fetal membranes to the uterus are numerous and firmly dovetailed. Should inflammation of these connections occur, adhesions form which prevent the throwing off of the foetal coverings so that they are retained within the uterus. The condition is common when cows have been kept in poor condition, or where the feed is improperly balanced. Mouldy feeds, or feeding of food stuffs that have undergone chemical change in some way are also contributing factors. The feeding of grain containing Ergot or Smut may cause abortion and retained afterbirth. The condition frequently exists in connection with Bang's disease.

Symptoms.

The symptoms of retention of the afterbirth are usually well pronounced. In addition to the retaining of some of the membranes, there will also be discharges of fetid products. As a result of the detention of this septic material within the uterus, inflammation is likely to take place which may lead to septicemia, emaciation, and, not infrequently, death.

Treatment.

In healthy cows the foetal membranes are usually expelled within twenty-four hours following parturition. Should the membranes be retained over a longer period than this, it can be assumed that inflammation of the uterus may be present, and this is responsible for the failure of their being expelled.

Injections of mild antiseptic solutions are recommended. Some prefer using warm water and salt. Should this be used the water should be boiled, allowed to cool to body heat and then half an ounce of table salt is added to every gallon of water. It is not advisable to introduce large volumes of irritating disinfectants into the uterus; should this be done, harmful results often follow. The use of iodoform in mineral oil has given good results in causing the expelling of the foetal membranes, but it is too dorous for use in dairy herds. Sometimes benefits are derived from the insertion into the uterus

of a capsule composed of equal parts of Boracic Acid and Charcoal. When it becomes necessary to remove the membranes manually the services of a Veterinarian should be employed.

Milk Fever

Milk Fever, also called Parturient Paresis, is a condition occurring in cows shortly after calving. There is a marked and rapid lowering of calcium in the blood of a cow suffering with Milk Fever, and the evidence of this deficiency usually occurs in from one to three days following parturition. Milk Fever is probably one of the most common conditions of dairy cows. It occurs almost exclusively in high producing cows, and especially in those that are in a well nourished condition. It is rarely seen following the first freshening, but occurs most frequently in cows from four to nine years of age.

Symptoms.

The early symptoms of the condition often pass unnoticed by the owner, but general depression and disinclination to move, partial or complete loss of appetite a few hours after calving are indications of impending trouble. In some cases the cow may appear excited and nervous, with twitching of the muscles and jerking of the legs. However, the majority of cases start with depression, which is followed by collapse and complete loss of consciousness. The animal lies with the head turned to one side—the body is cold to the touch, the muzzle is dry and the eyes are dull and expressionless.

Prevention.

Many cases of Milk Fever can be prevented by not milking all the milk from the udder for several days following freshening. The cow should also be given the proper ration throughout the gestation period. Should she be deprived of the proper minerals during this critical time she would be more likely to go down with this trouble.

Treatment.

There are two methods of treatment advocated for Milk Fever, but no matter which one is used they should be given at the first indication of the trouble. The Veterinarian, as a rule, prefers the injections of Calcium Gluconate, but this must be given with care, otherwise severe irritation to the skin and the formation of abscesses are likely to follow. For the small dairy farmer, where the services of a qualified Veterinarian are not available, we believe the inflation of the udder with air is still the most satisfactory and safest method to follow. Milk Fever outfits are obtainable at a very small cost, and if care is taken in seeing that the equipment is sterile

there should be no bad results following udder inflation. Before injecting air into the udder, the teats and mammary glands should be washed with warm soapy water and dried with a sterile towel.

The teat orifices should receive special attention by careful disinfection. Each quarter should be fully distended with air and the teat orifices closed with adhesive tape. The tapes should not be removed for at least three hours, when the udder can be reinflated if necessary. The animal should not be allowed to lie on its side, but be braced up so that it lies on its sternum. No medicines should be given by the mouth, for often the animal is unable to swallow, and any liquids given by this channel are likely to go directly into the lungs and Pneumonia results.

Mastitis

Mastitis, or inflammation of the udder, is an infectious disease, particularly affecting dairy cattle. The organisms causing the disease may be carried on the hands of the milker, or by the teat cups of milking machines. Flies may be carriers of infection, and insanitary floors and stalls may also be the means of spreading disease. These bacteria gain entrance to the udder through the opening in the teat and set up an inflammation in the glandular structure of the quarter. There are two forms of Mastitis recognized by dairy men, viz., Acute and Chronic. All female cattle are liable to infection, but cows five years of age, or even older, are apparently the most susceptible.

Symptoms.

Mastitis is generally a chronic infection, although an acute type sometimes occurs. In the acute type the symptoms appear suddenly and will be indicated by loss of appetite, sudden decline in milk flow and the udder becoming swollen and inflamed, and the milk watery, bloody or stringy. The acute form, while usually not fatal, results in a chronic infection. In the chronic type of Mastitis there is a gradual development of the symptoms of the udder and milk. A common symptom in Chronic Mastitis is that abnormal milk may be noticed at irregular intervals, extending over various periods of time. Eventually the affected quarter ceases to function and not infrequently other quarters undergo similar changes, until two, or even more, of the mammary glands become non-milk secreting.

Treatment.

As a rule, acute Mastitis cases will make a satisfactory recovery provided treatment is properly applied in the early stages of the disease. Should chills be observed, stimulants

should be given. Bathing the udder frequently with hot water and the use of hot blankets will also be found beneficial. All milk should be removed from the udder at least every two or three hours. External applications are advocated in the form of salves, ointments and liniments, but it is doubtful if there is anything superior to warm Camphorated Oil. This should be carefully massaged into the udder several times daily. We cannot over-emphasize the importance of heat to the udder, either in the form of hot water, or even hot wool packed around the udder and held in place by a suspensory bandage. The grain ration should be reduced and the animal given warm bran mashes and roughage only.

The treatment of Chronic Mastitis is, however, a much more serious problem. The early diagnosis of the disease is of the utmost importance in order to prevent the spread of infection to other cows in the herd. Examination of the milk to detect clots (an early symptom of Chronic Mastitis) can easily be made by the dairyman. A simple method is to pass the first few strips of milk from each quarter tthrough a black cloth. The clots are then easily discernible on the black background. Another method is to pass the milk through a fine sieve. There are, of course, technical tests that can be made which will give a positive diagnosis, but the examination for clotting of the milk is so simple that anyone can apply it.

We believe the spread of Mastitis can largely be controlled by the detection of affected cows and the practicing of sanitary measures. Any cows that have udders hopelessly affected should be removed from the herd and sent to the Packing Plant. Those which are only slightly affected may be treated, and quite a large percentage may be brought back to normal production. All healthy cows in a herd should be milked first, leaving suspected animals, or those with slight symptoms, to the last. The disinfection of all udders before milking, as well as the disinfection and cleaning of the cups of milking machines (providing such are used) will aid greatly in preventing the spread of Mastitis.

Several Biological Houses are advertising Mixed Bacterins (Bovine Origin) made from organisms found in cases of Mastitis, and there is reason to believe they will raise the immunity against this disease, but when the symptoms have already made their appearance, the injection of certain preparations into the affected quarter through the opening at the end of the teat can be used to advantage. There are several of these preparations now on the market, and new ones will shortly be available. Full information regarding these can be obtained at your local Drug Store, and the directions for using them are on the bottle.

Pneumonia

Pneumonia is an inflammation of the lung substances resulting in parts of the lung tissue becoming solid and the filling of the air cells with exudate. The condition may be brought about as the result of any of the following factors: Specific organisms, exposure to cold, or improper housing in damp or drafty quarters.

Symptoms.

The early symptoms are usually indicated by dullness, loss of appetite, high temperature (104-107°) rapid breathing, roughened coat, dilated nostrils. A cough may, or may not, be present in the early stages. The animal usually stands with the forelegs spread apart with the elbows turned outward. The horns, ears and limbs are cold. Upon examination of the chest walls, wheezings or gurgling sounds are heard. These depend upon the extent of infection in the lungs and the stage into which the disease has developed. There is usually a discharge from the nostrils—this will vary in consistency from a clear watery fluid to a heavy whitish yellow material.

Treatment.

If Pneumonia is to be treated successfully the affected animal must be housed properly and protected from drafts and cold winds and rain. The feed should be easily digestible and palatable, given frequently in small quantities. Stimulants given by the mouth, such as Aromatic Spirits of Ammonia, in doses varying from one to three ounces, depending upon the size and age of the animal, will be found helpful. This should be mixed with a pint of warm water and given every few hours. Nitrous Ether in doses of from one to two ounces, given in water, is also satisfactory. Anti-Bacterial Serums, of Bovine origin, are also useful. These are injected hypodermically and repeated at frequent intervals. Full information regarding Serums can be obtained at any Drug Store. Mustard plasters or other counter-irritants applied to the chest walls are of value, especially in the early stages of the disease.

Considerable publicity has been given to the use of Sulfanilamide. Our experience has been that it can be used to advantage in certain cases, but the amount to be given and how frequently it should be administered should be left to the judgment of qualified persons. Quinine, **when obtainable,** was a valuable drug in the treatment of Pneumonia. It was an internal antiseptic, and had a stimulating action in small doses, but most important of all, it lowered the temperature and diminished tissue change. Drastic purgatives in the treatment of Pneumonia should be avoided. The affected animal should

be kept warm, blanketed, and housed in a properly ventilated stall.

Calf Pneumonia

Calf Pneumonia is a common disease of young calves, especially between the ages of one to two months, and frequently causes heavy losses in some dairy herds. It may occur at any season of the year, but it is most prevalent during the winter months. Calves kept in damp, dirty and poorly ventilated pens are usually those affected. In addition, animals that are improperly fed and under-nourished are particularly susceptible.

Symptoms.

The first symptom usually noticed is a depression; this will be followed by an increase in temperature, rapid breathing, coughing and loss of flesh. The disease usually runs its course in from seven to fourteen days. As a rule, the mortality rate is high.

Prevention.

Sick calves should be removed to clean dry quarters and kept apart from healthy animals. The pens that have contained the sick calves should be cleaned and thoroughly disinfected. Proper feeding and care are essential. Calves may be given considerable protection against Pneumonia by vaccinating them with a suitable Mixed Bacterin (Bovine); this may be administered shortly after birth and will aid in building up an immunity during exposure.

Treatment.

It has been found that a satisfactory treatment for this condition is the use of Anti-Bacterial Serums (Bovine). The Serum should be injected at 24 hour intervals as long as necessary. Stimulants given by the mouth and the use of Sulfanilamide may be of benefit in some cases. If it is at all possible, the services of a qualified Veterinarian should be obtained, as serious complications frequently occur, making it most difficult to handle outbreaks of the disease in a satisfactory manner.

Calf Scours

Calf Scours is an acute infectious disease of young calves. The animals affected usually vary in age from two to six days. Should the outbreak be a virulent one it may spread to calves several months old. The disease is caused by several organisms, especially those which belong to the colon bacillus group. It is more common in calves housed in insantiary pens, and is more prevalent during the winter months. However, it may occur at any season of the year and even in calves kept under

apparently satisfactory conditions. Infection may take place through the navel cord immediately after birth, or through the digestive tract, but probably the most common means of infection is from contaminated bedding, or through contact with sick calves on the premises.

Symptoms.

The calf may be born apparently in the best of health, but within two to five days show evidence of a profuse yellowish white diarrhoea. The affected animal will show well marked depression. The coat is dry, the flanks show a tucked-up appearance, the discharges adhere to the hindquarters, and the hair will be matted and soiled. Should the attack be a severe one the calf quickly develops inflammation of the digestive tract and lung complications which may result in death.

Prevention.

Every precaution should be taken to see that the newly-born calf is not over-fed, and the milk should be given at the proper temperature in a scrupulously clean vessel. The calf should not be exposed to dampness, cold and drafts. We believe calves can be immunized to a considerable extent by the use of Anti-Bacterial Serums and Mixed Bacterins (Bovine). It should be borne in mind that strict sanitary measures are necessary if the disease is to be controlled on dairy farms. Once infection has occurred every possible means must be taken to prevent it from gaining a foothold. The proper use of disinfectants on floors and walls of the calf pens will also aid considerably in preventing the spread of infection.

Treatment.

Medicinal remedies have not proved satisfactory in the treatment of this trouble. Castor Oil, Subnitrate of Bismuth, Formalin and Lime Water have been tried with varying results. The strength of the calf should be maintained by giving raw eggs in pasteurized milk. Recently, Sulfaquanidine is being widely used in the treatment for Calf Scours and other intestinal disorders. This drug is given either in bolus or powdered form, and is administered by the mouth. As a rule, a few doses of the drug results in correcting the condition. Sulfaquanidine may be purchased at your local Drug Store, with full directions as to the dose required.

Bloat

Bloat is a common disorder of cattle; it is due to the excessive accumulation of gas in the rumen. Owing to the large quantity of food contained in this stomach, any disutrbance of its natural function may result in a serious condition. As a

rule, the trouble arises from over-eating and a decomposition of food stuffs that are either prevented from escaping by obstructions or that have formed in such quantities that they cannot be eliminated fast enough to relieve the condition. Sweet Clover, Alfalfa and Wet Rape are probably the most common food stuffs likely to produce bloating. It is believed that many cases of Bloat occur as the result of the animal being unable to eliminate the accumulations of gas by which they are expelled in a normal way. Investigations indicate that some of the gases formed are toxic and produce a paralyzing effect upon the rumen, with the result that belching does not take place. It has been found that Bloating occurs most frequently when cattle are fed on thick immature stands of Alfalfa or Clover, but when these legumes are mixed with grasses Bloating is not so likely to occur. It is, therefore, reasonable to suppose that if expulsion of the gas from the rumen is the result of fibrous material producing a mechanical reaction on the lining of the stomach, and expels the gases by belching, that the conddition could often be prevented by adding fibre to the ration at the time legumes are being fed. The incident of bloating is influenced by weather conditions as well as the condition of the animal when the forage is consumed.

Symptoms.

The first indication of bloating noticed by the owner may be that the animal stands quietly with the back slightly arched. Swelling of the left flank will shortly follow—and in some cases the entire abdomen may be enlarged to enormous proportions. The breathing becomes difficult, the nostrils dilated, the mouth is open, and the tongue protrudes. Moaning and grunting will also be heard. As a result of the pressure of accumulated gases on the heart and respiratory organs, suffocation may occur, or occasionally the paunch may rupture under the strain and death occur.

There are several suggestions for the prevention of Bloat that should be given careful consideration. Care should be taken when cattle accustomed to dry feed are turned into succulent pastures. If the animals could first be fed on dry feed before being turned into green forage, the dangers of bloat could be greatly lessened. It is of the greatest importance to avoid allowing hungry animals to consume large quantities of Alfalfa, Sweet Clover or Rape, especially when it is wet with rain or dew. Care should also be taken to see that the animals do not consume too much water after having filled themselves with green food.

Treatment.

There are many suggestions for the treatment of bloating in cattle. A piece of wood or rope placed in the cow's mouth will sometimes stimulate the flow of saliva; this will encourage swallowing, and in this way open the esophagus and assist in allowing the gas from the rumen to escape. Vigorous rubbing and kneading of the abdomen may also be the means of helping to give relief. When it becomes apparent that immediate measures must be taken to relieve the animal, tapping should be resorted to. The operation is done with an instrument known as a "trocar" and Canula. A small incision should first be made in the skin in the left flank at a point situated at an equal distance from the last rib—the hip bone and the back bone, where the vertebrae project outward in the region of the loin. Following the making of the incision the Trocar contained in its covering should be forced through the abdominal wall into the rumen. The Trocar should then be withdrawn, leaving the Canula, or sheath, in the paunch to allow the gas to escape. When the formation is not excessive medicinal treatment may be all that is necessary to bring about recovery. Two ounces of Aromatic Spirits of Ammonia in a pint of water, given every half hour, or one to two ounces of Spirits of Turpentine in either milk or oil is also satisfactory. Hyposulfite of Soda in one ounce doses, dissolved in water, is an old but reliable remedy.

The animal should be fed carefully for several days after the bloating has subsided, in order to allow all fermenting material to pass from the rumen.

Ringworm in Calves

Ringworm is a disease of the skin which may occur in any of our farm animals, but is more common in cattle; it is also readily transmitted to human beings. The disease is more prevalent in calves and yearlings than in older animals, as well as in stock kept under insanitary surroundings and those that are in poor condition. The disease is due to a variety of fungi, but the one most frequently seen in cattle affects the upper layers of the skin and is readily transmitted from one animal to another.

Symptoms.

The fungus establishes itself at the base of the hair follicles, which soon causes changes in the root and shaft of the hair, rendering it brittle and broken and showing a ruffled appearance. Shortly after this circular patches appear, especially on the skin around the eyes and mouth, although in some instances these affected areas may be found in almost any

place on the body. Due to the inflammation of the skin and the exudate thrown out, scale grey crusts form over the spots affected. As the disease progresses the crusts grow darker and may even turn to a brown color.

Treatment.

As a rule Ringworm is not difficult to cure. In order to enable any medicinal dressing to come in contact with the fungus the crusts should first be removed with warm water, soap and washing soda. The affected parts may then be treated with any of the following:

1. Lard, five (5) parts; Sulphur, one (1) part.
2. Ordinary Tincture of Iodine applied with a soft brush.
3. Vaseline, five (5) parts; Iodine, one (1) part.
4. Mercurial Ointment is a very satisfactory treatment for this condition, but it should not be applied over a large area, as poisoning is apt to occur.

Calves showing symptoms of the disease should be separated from the non-affected. The pens that have contained affected animals should be carefully cleaned and disinficted. Persons treating animals suffering with Ringworm should wash and disinfect their hands carefully after handling these cases, as the disease is readily transmitted to humans.

"Foot Rot"

This is a common disease and is frequently seen in pastured cattle during dry as well as in rainy seasons. Mud holes in a pasture where animals stand during the hot hours of the day are probably the most common sources of infection. Also muddy approaches to watering troughs, or where the overflow runs through the barnyard, are often the cause of the trouble occurring. Once the disease occurs on a farm it is likely to return each year unless these mud holes are drained or fenced—or in the case of wet places around watering troughs, are filled in and given proper drainage. There are several suggestions made to prevent this trouble, one being to place a box containing lime in front of the stable door. The box should be shallow, but strongly made of 2x4's, and large enough that the cattle must walk through it on their way into the barn. This box should be filled with slacked lime, the contents must be stirred frequently with a rake or fork in order to keep it loose and prevent it packing down.

Symptoms.

Great lameness is an early symptom of the disease. Heat and swelling will be found either between the claws, above the hoof or, in some cases, several inches above the top of the foot in the tendons on the back part of the leg. If the disease is

neglected the inflamed areas may soften and slough and deep abscesses form, and the pus burrow between the bones and the wall of the hoof. Should this occur treatment will be difficult and recovery is likely to be slow.

Treatment.

In the early stages of the disease, before suppuration takes place, the swelling and pain can often be reduced by warm poultices of flaxseed meal or bran. Prior to applying the poultice the foot should be thoroughly cleaned with one ounce of Carbolic Aid to a pint of water. After the inflammation has been reduced by poulticing, should the skin be unbroken, packs soaked in vinegar and kept in place over the affected part, will aid in preventing the spread of infection. Should the swelling be localized around the top of the hoof head, the foot should be soaked several times daily in hot creolin solution. Should the swelling break and be followed by abscesses, which burrow into the tissues, these should be carefully syringed out with a carbolic acid solution (1 part Carbolic Acid to 40 parts water), and then the foot covered with a wad of oakum or cotton smearked with pine tar. This can be kept in place by a bandage.

The application of Cresol Compound or pure Creolin applied to the raw surfaces after they have first been cleaned thoroughly with Carbolic Acid solution, is also a satisfactory treatment in many cases.

Tuberculosis

On account of the many inquiries for information regarding Tuberculosis, it has been considered advisable to include in this discussion of the diseases of cattle, some of the important points in connection with the control of the above mentioned disease.

All cattle owners are aware that Tuberculosis is infectious and communicable, and that it is caused by the Tubercle Bacillus. Its occurrence, in so far as the Province of Alberta is concerned, is not considered extensive; at least, this would be indicated by the numbers of reactors found when the Tuberculin Test is made. It should be borne in mind, however, that owing to the scarcity of Veterinary Inspectors and the rapid increase in cattle production during the past few years, only a small proportion of our cattle population have been submitted to the Tuberculin test.

According to available information, Tuberculosis in cattle is usually found in herds that are closely housed in stables that are damp and poorly ventilated. These conditions are not sufficient to cause the disease, but will lower the animal's

resistance against infection and make it susceptible to the Tubercle Bacillus. The disease is usually introduced into a clean herd by the addition of an infected animal. For this reason no new animals should be added to a herd until they have passed the Tuberculin test.

The symptoms of Tuberculosis depend upon the extent of infection and the organs involved. In a large number of cases no clinical symptoms are noticeable. On account of the reasons stated the only positive diagnosis that can be made is by the Tuberculin test.

There are three tests that may be applied, which are as follows: The Intradermal, the Subcutaneous, and the Opthalmic.

The first mentioned is the one principally used in Tuberculosis eradication, both in Canada and the United States, and is the only one that needs to be mentioned in detail here. The application of the Intradermal test is made by injecting a few drops of Tuberculin between the layers of the skin in the caudal fold at the base of the tail. Should a reaction occur a swelling at the point of injection is observed from 72 to 96 hours after the injection. The interpretation of the swelling is made by the Veterinarian making the test.

The control of Bovine Tuberculosis in Canada comes under the direction of the Dominion Department of Agriculture, Ottawa, and the various policies supervised by them are set out hereunder:

Accredited Herd Plan.

The object of this plan is the eradication of Tuberculosis in purebred breeding herds. These herds are Tuberculin tested free of charge by salaried Veterinary Inspectors.

To be eligible for acceptance under this plan a hard must contain at least ten purebred cattle of one breed registered in the applicant's name. The number of purebreds must, however, comprise at least one-third of the total number of cattle in the herd.

As soon as the herd has passed two annual or three semi-annual tests, without a reactor, and contains at least ten registered purebreds, it is designated a "Tuberculosis free Accredited Herd".

Compensation paid for reactors is based on two-thirds of the valuation placed upon the animals by Veterinary Inspectors of the Health of Animals Division. The maximum amount of compensation permitted under the Act is $100 for purebreds and $40.00 for grades. Compensation on a purebred basis is not paid for reacting animals over six months of age not

registered at the commencement of the tuberculin test. Animals affected with Lump Jaw and grade bulls must be slaughtered without compensation if they react to the test. All reactors must be slaughtered under Federal inspection.

Supervised Herd Plan.

The supervised herd plan is a single herd policy applicable to grade herds irrespective of the number of purebred or grade animals they contain. No compensation is paid for reactors, but the owners receive whatever proceeds there may be from the salvage.

Owners placing their herds under the plan must agree to slaughter reactors, to promptly cleanse and disinfect their premises, and to keep their cattle from coming in contact with untested animals. If a herd sire is not maintained on the premises, breeding operations must be restricted to a tested animal.

Restricted Area Plan.

The object of this plan is the eradication of Tuberculosis in definite areas. At least two-thirds of the cattle owners in any definite area must sign a petition for the establishment of such an area under this plan. This petition must be forwarded by the Provincial Minister of Agriculture to the Minister of the Dominion Department of Agriculture requesting that the necessary action be taken. The payment of compensation is based on the same limitations and maximum valuations provided under the Accredited Herd Plan.

Gestation Table for Cows

Breeding dates	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Day	Calving Dates											
1	Oct. 10	Nov. 10	Dec. 8	Jan. 8	Feb. 7	Mar. 10	Apr. 9	May 10	June 10	July 10	Aug. 10	Sept. 9
2	11	11	9	9	8	11	10	11	11	11	11	10
3	12	12	10	10	9	12	11	12	12	12	12	11
4	13	13	11	11	10	13	12	13	13	13	13	12
5	14	14	12	12	11	14	13	14	14	14	14	13
6	15	15	13	13	12	15	14	15	15	15	15	14
7	16	16	14	14	13	16	15	16	16	16	16	15
8	17	17	15	15	14	17	16	17	17	17	17	16
9	18	18	16	16	15	18	17	18	18	18	18	17
10	19	19	17	17	16	19	18	19	19	19	19	18
11	20	20	18	18	17	20	19	20	20	20	20	19
12	21	21	19	19	18	21	20	21	21	21	21	20
13	22	22	20	20	19	22	21	22	22	22	22	21
14	23	23	21	21	20	23	22	3	23	23	23	22
15	24	24	22	22	21	24	23	24	24	24	24	23
16	25	25	23	23	22	25	24	25	25	25	25	24
17	26	26	24	24	23	26	25	26	26	26	26	25
18	27	27	25	25	24	27	26	27	27	27	27	26
19	28	28	26	26	25	28	27	28	28	28	28	27
20	29	29	27	27	26	29	28	29	29	29	29	28
21	30	30	28	28	27	30	29	30	30	30	30	29
22	31	Dec. 1	29	29	28	31	30	31	July 1	31	31	30
23	Nov. 1	2	30	30	Mar. 1	Apr. 1	May 1	June 1	2	Aug. 1	Sept. 1	Oct. 1
24	2	3	31	31	2	2	2	2	3	2	2	2
25	3	4	Jan. 1	Feb. 1	3	3	3	3	4	3	3	3
26	4	5	2	2	4	4	4	4	5	4	4	4
27	5	6	3	3	5	5	5	5	6	5	5	5
28	6	7	4	4	6	6	6	6	7	6	6	6
29	7	....	5	5	7	7	7	7	8	7	7	7
30	8	....	6	6	8	8	8	8	9	8	8	8
31	9	....	7	....	9	....	9	9	....	9	....	9

Date Due